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VOLUME - 2

Project Notebook

COPY NO. 69

MANNED ORBITING LABORATORY PROGRAM

Wm B Dibon

MOL PROJECT DIRECTOR

INTERNATIONAL BUSINESS MACHINES CORPORATION

9045 LINCOLN BLVD. • LOS ANGELES, CALIFORNIA 90045

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CUSTOMER NAME:	Satellite Control Facility Bird Buffers Space Systems Division Inglewood, California
REGION:	GEM
DISTRICT:	Western
BRANCH:	Los Angeles Westchester
BRANCH MANAGER:	Skip Hoyt
ACCOUNT MANAGER:	Ed Chappelear
DP SALESMEN:	Bob Fairbanks Bob Krause Bob Oller
FSD REPRESENTATIVES:	Johnny Jones Jim Selfridge Glen McClure

BIRD BUFFER CONFIGURATION - SINGLE

ITEM	NO.	EACH.	BB TOTAL	SYSTEM	SUB TOTAL
160A Main Frame	1	2250	2250		
166-2 Printers	4	690	2760		
169-2 Memory (16K)	1	2000	2000		
167 Card Reader	1	460	460		
603 Tape Drives	4	550	2200		
161 On-Line Typewriter	1	262	262		
162-3 Data Synchronizer	1	600	600		
Cost per Single BB			10532		* 94,788
Computer (Each 10532)					** 264,028

STC BLACK ROOM CONFIGURATION - 160A USED FOR CLASSIFIED PROJECT	160A SYSTEM	SUB TOTAL
		*8,000
	Approx. 8,000	** 272,028

C.1 AFSSD has asked if IBM can provide (4) 2250's, Mod. 1 or Mod. 2, for use at the Satellite Test Center. They have also asked if IBM can provide an interface box to interface the 2250 to the CDC 160A. Delivery is required as soon as possible. DP Scheduling has indicated that a 2250 Mod. 1 may be available between March 15 and April 1, 1966. FSD has developed a ball park price to the customer for the interface box as follows:

Quantity of 1	$35,000
Quantity of 10	$12,000
Quantity of 40	$ 8,000

FSD is trying to trim their schedule to meet the 2250 schedule.

Customer wants all equipment GSA but will probably accept purchase of the interface box.

PRELIMINARY BRIEF OF EXPECTED RFP FROM AFSSD FOR THE BIRD BUFFER SUBSYSTEM

PART I. Hardware Configuration and Operational Control

For design purposes, it can be assumed that the primary reason for updating the bird buffer subsystem is to reduce the scope of manual control over data flow between the STC and the RTS and to facilitate and expedite the issuance of non-programmed commands from the STC to the RTS and the orbiting vehicle.

The present bird buffer subsystem (hereafter call the multiprocessing subsystem - See Attachment I) will be replaced by a multiprocessing system (See Attachment II) with shared memory. Memory protect will be required in order to prevent the destruction of secure data in storage due to programming errors and to prevent compromising classified information contained the in the data. The multiprocessing system will operate under Executive Monitor (EM) control with the EM routing data to specified locations in core. The core lock-out feature will prevent storage from being addressed in unauthorized (secured)locations. Control of the STC data handling system will be centered in the multiprocessing subsystem. Although manual overrides will be provided, all instructions issued to the off-line computers[1], the RTS computers, and the orbiting vehicle, will pass through and be under the management of the EM of the multiprocessing subsystem.

Data channels from the remote sites will feed directly into the processing units under EM control without passing through a Computer Communications Converter (CCC) or switching unit. The functions presently performed by the CCC and switching unit will be performed by the CPU's under EM control. Core-to-core transfer of data between the multiprocessing subsystem and the off-line computers will be provided in order to utilize the off-line computing capabilities during mission operations. The off-line computers primarily determine orbit parameter changes, vehicle command loads, and telemetry processing mode tables, based upon predicted latest actual data received from the RTS's. "Keys" (Codes - either manual or programmed) can be maintained in the multiprocessing subsystem EM to allow off-line computer access to information stored in locked out (secure) storage if this information is necessary for computations.

The multiprocessing subsystem will assume more direct control over the RTS/STC data flow than is presently being exercised by the bird

(1) NOTE: The off-line computers are those processors which perform computational requirements which are considered non-real time or non-pass mode oriented. These processors may or may not be part of the multiprocessing subsystem, as the customer dictates.

buffers. The multiprocessing subsystem will operate a set of diagnostic programs in the prepass mode to ascertain RTS operational readiness and establish the "real time near" condition. During pass mode the multiprocessing subsystem will transmit all non-programmed commands and changes to telemetry processing modes, as well as programmed instructions, through direct communication with the RTS Computers.

During mission operations, all instructions addressed to the multiprocessing subsystem will originate at the mission center, which will have direct communication with the multiprocessing subsystem EM via CRT-Keyboard devices.

The Mission Center displays will be driven directly by the multiprocessing subsystem. The displays will be CRT alphanumeric and will have the capability to present all data from the RTS's necessary for mission control. The display capability will be such as to allow the selection of specific data for display which represent areas of immediate concern or areas which indicate a need for immediate change from normal operational modes. Based upon displayed information, the mission director will be able to issue instructions to the multiprocessing subsystem (through a display console) for transmission to the RTS and hence to the orbiting vehicle. The mission director will also be able to direct the off-line computers, through the multiprocessor subsystem, to perform orbital parameter updates, ephemeris changes, and processing mode changes in conjunction with the commands recently issued to the orbiting vehicle or the RTS Computers. In this manner, the mission center will be able to maintain software configuration control over the STC data handling system.

Software configuration control at the RTS Computers will be maintained by the multiprocessing subsystem at the STC. The EM in the multiprocessing subsystem will contain a job table which specifies software configuration and processing priority at the RTS. This job table can be updated in "real time" by commands from the mission center display console.

The multiprocessing subsystem will be fail-soft and provide a "graceful degradation" of mission processing in the event of equipment malfunction. A voice net from the mission center to the RTS will be provided for use in the event of "graceful degradation" mode occurrance, or in the necessity of manual override of processing modes during normal operations.

The system will be designed so that all communications with the RTS computers and the off-line computers will pass through the multiprocessing subsystem; however, a voice link will be maintained between the STC and the RTS in the eventof equipment maulfunction at the STC.

SUMMARY

Features to be provided the STC data handling facility which are not now available in the present bird buffer system.

1. The Bird buffer subsystem will be replaced by a multiprocessing system utilizing shared memory with memory protect.

2. The multiprocessing subsystem will automatically ascertain the operational readiness of the remote sites and maintain configuration control and processing priority of the RTS computer programs.

3. Switching hardware presently utilized at the bird buffers will be deleted and the RTS data channels can be selected by the EM of the multiprocessing system for processing and/or storage.

4. The real-time multiprocessing subsystem CPU's will have direct communication with the off-line CPU's during all phases of operations. If required, a method will be provided to allow the off-line CPU's access to

data stored in secure locations, under the scrutiny of the executive monitor and/or a manual Control Console.

5. All displays for the Mission Center (Mission director station) will be directly driven by the real-time multiprocessing subsystem CPU's.

6. The displays will be CRT-Alpha-numeric and will display all information necessary for the system controller to maintain control of all missions. Display consoles and on-line keyboards will be provided for direct communication back to the multiprocessing subsystem. There I/O equipments will be utilized by the system controller to issue non-programmed Commands and processing mode changes through the multiprocessing subsystem to the RTS Computers. These instructions will be based upon decisions made after viewing the CRT displayed information.

7. The multiprocessing subsystem will be fail-soft and provide a "graceful degradation" of mission processing in the event of equipment malfunction. A voice

net from the mission center to the RTS will be provided for use in the event of "graceful degradation" mode occurrance.

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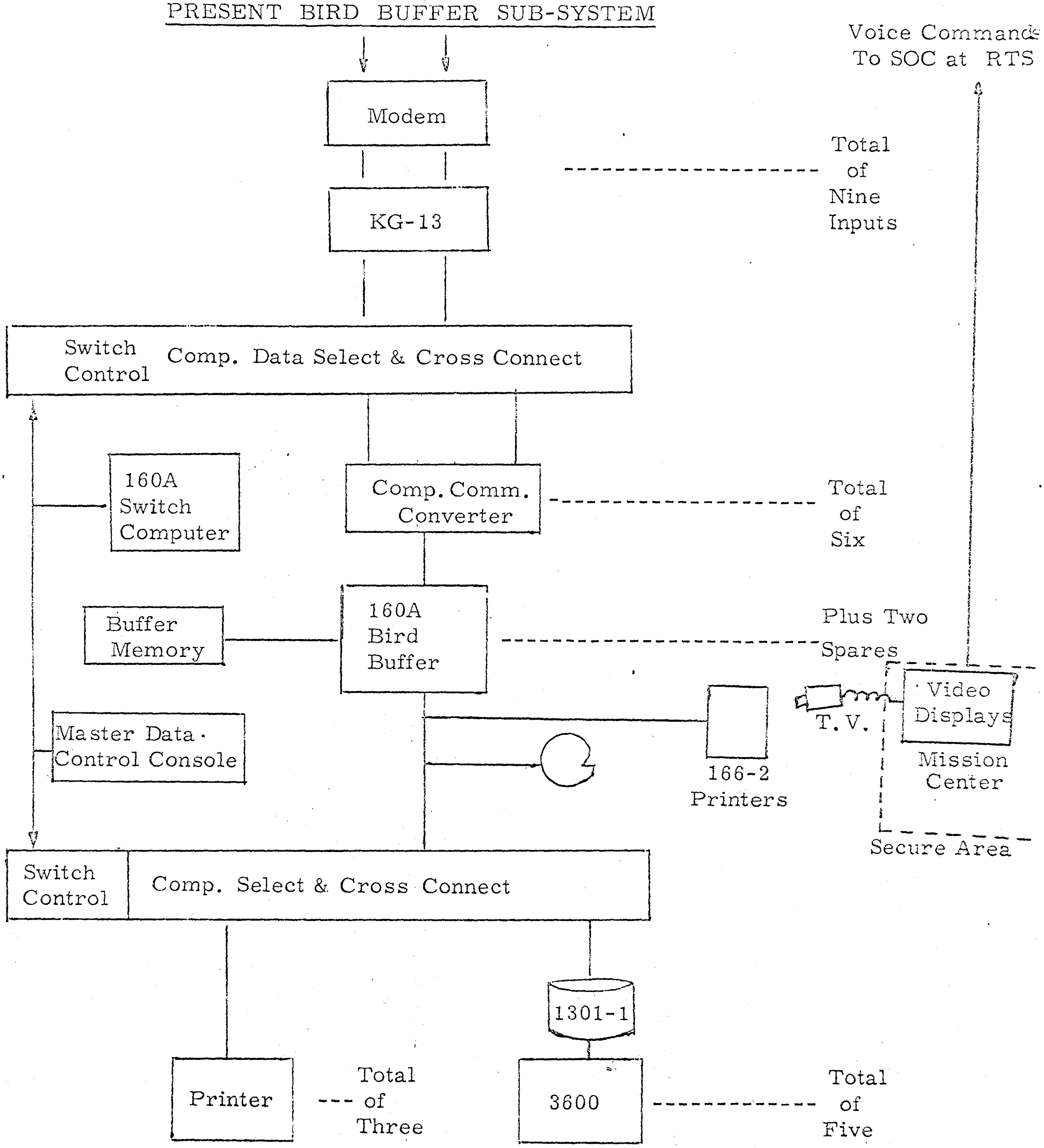
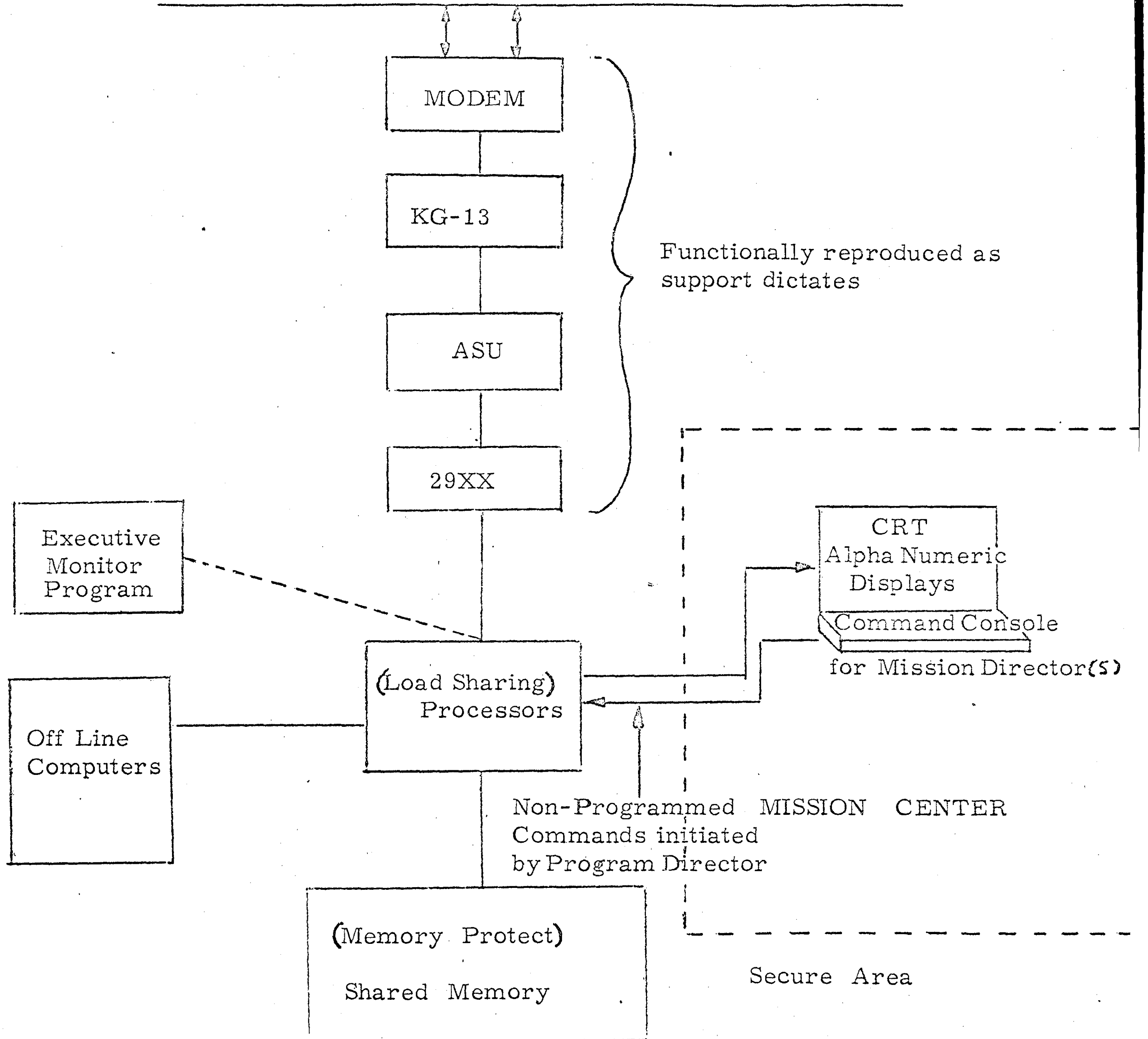
PRESENT BIRD BUFFER SUB-SYSTEM



PROPOSED BIRD BUFFER SUBSYSTEM CONFIGURATION



PRELIMINARY BRIEF OF EXPECTED RFP FROM AFSSD FOR THE BIRD BUFFER SUBSYSTEM

PART II. Software

The programming system will be integrated for the new STC multiprocessing subsystem (MPS). It will include an Executive Monitor, assembled library routines, input/output control program (all peripherals including the 3600's), a JOVIAL Compiler, an assembler and a loader. All multiprocessing subsystem programs must operate under control of the Executive Monitor (EM).

- Executive Monitor Characteristics

  The EM will control operations on all multiprocessing CPU's and will permit easy transition between STC modes of operation by previously scheduled information and modes of operation dictated by manual operator intervention. Information on interrupted in-process jobs will be preserved so that the processing may be completed at a more propitious time. The EM should be designed so as to guarantee the following:

  a) Standard communications between the CPU's and any operator-user.

  b) Real-time access to the MPS library programs to take full advantage of written, tested code.

c) I/O assignment tables with automatic handling of hardware locations and flags associated with traps, interrupts and special registers.

d) Standard linkage from object programs and system programs to commonly used subroutines within the EM.

e) Task assignment to available processors in prioritized order, using a multi-processing philosophy.

f) Provision of a job execution status report upon request.

g) Standard job accounting and record keeping routines for MPS operations.

h) Direct communication with the off-line 3600's in order to utilize the additional computational capabilities.

Multiprocessor Characteristics

A multiplicity of program execution is heduled by the EM which also controls the time-sharing of I/O, memory, and processors. This should be accomplished by use of a job table specifying a list of current programs and their status, and a memory map specifying available, in use, or unavailable (secured) areas. The EM will also maintain tables containing file information and control usage of each I/O device. Accordingly, a single program should be able to be executed simultaneously by the two processors utilizing different sets of data. The total multiprocessing system should appears as one computer to the programmer.

- Compiler - EM Relationship

Whenever a program has been read into memory for execution, specific program points should enable program segments to operate in parallel. When these points are reached, the EM is entered. The action of the EM at these entrance points depends on the type of executive call made. The assembler or compiler must be able to accept the imperative statements of the programmer which direct the EM to a course of action and translate these statements into entrance instructions forthe EM. In addition, the assembler must construct all other entrance parameters and a job table.

- Job Table

  A Complete set of tables should be loaded by the EM to guarantee that the monitor has knowledge of all possible parallel processing at that moment.

- System Design

  Debugging on simulation tools must be available, as well as the ability to run the program totally on one CPU. The compiler should not demand that the task to be performed is performed on multiple processors. Scheduled tasks should be able to be changed in real-time. New tasks should be able to be defined at any time. Memory conflicts should be automatically solved when CPU's are attempting to get to the same memory module.

- Central I/O Control Program

  Input and Output to the CPU's will be controlled by a Central I/O control program (IOC) which is, of course, controlled by the EM. The IOC will:

  a) Control the reading/writing of records

  b) Provide for overlapping I/O reading, writing and computing.

c) Perform automatic blocking and deblocking of disc file records.

d) Check reading and writing errors and correct program corrigible errors. Error analysis should be attempted in all cases.

e) Provide sequential and random processing of data on the disc files.

f) Schedule the use of disc file arms including automatic handling of arm failure

g) Alter I/O unit assignments if necessary at execution time by means of manual intervention.

h) Insure that MPS disk packs are properly formatted and contain standard labels. Labels should be written upon output and read on input.

i) Check/Process end-of-data file conditions.

j) Write recovery-flags to facilitate restart recovery.

The IOC will provide for standard operator program communications. It must be accessed operationally by on-system programs by means of appropriate assembler/compiler MACROs. No program should be able to initiate I/O directlt without the use of MACRO's. Execution of MACRO-constructed instructions will necessitate entry to the Executive, and the Executive will control and monitor the IOC.

- Storage Protection

  A storage protection feature shall be provieed to preserve a program if another erroneously attempts to store over it, whether the storage medium is core or disc. Storage operations from either a CPU or Channel will be subject to this feature.

  Programs should be self-checking with program or machine error producing a unique interrupt condition so that the cause of the error may be easily ascertained.

  Software must automatically initiate corrective action to the fullest possible extent.

Examples of necessary and desirable interrupt conditions are as follows:

A. Internal (Processor Generated) Interrupts:

   1) Illegal instruction executed
   2) Halt instruction executed
   3) Arithmetic overflow
   4) Real-time clock overflow
   5) Attempt to write out of bounds
   6) Parity error from memory
   7) Interrupt a computer
   8) Initiate I/O
   9) Store interrupt mask register

with just one processor functioning. This requiremen must specifically guarantee that:

a) I/O activities can be initiated on any channel from any CPU.

b) The EM is not to be permanently associated with any of CPU's, nor does it require the complete attention of a whole CPU.

c) CPU's must respond to all types of interrupts, including I/O interrupts. To avoid duplicate handling of I/O interrupts, one CPU could be designated to receive such interrupts at any one time.

d) Programs must be capable to operate correctly on either CPU, or if both are available. If a system component fails during task execution, the EM must be able to sense the condition, reassign I/O units, and continue operations. If necessary, it should be able to take steps to service tasks in a degraded mode.

In particular, if any CPU fails, the EM must reassign its current task to one of the other CPU's. Possible methods for notifying the CPU's that another has malfunctioned might be:

1. A unique interrupt signal is generated, by a malfunction which interrupts the other CPU.S

2. The malfunction makes a status register - addressable by one of the other CPU's and tested each time the EM is operated therein - to change state.

NOTE: In either case, the EM when operated by the still-functioning CPU should take note, institute recovery action, and output appropriate alarm messages.

As mentioned earlier, the CPU's must be able to receive and act on I/O interruptions, but only one CPU is so designated at any one time. When the EM schedules tasks to a CPU, or attempts to find tasks and fails, it determines which CPU has the lowest priority activity and selects that one to receive I/O interruptions, until the next task assignment is considered. If a malfunction occurs in the designated CPU, the EM should automatically switch I/O interrupts to an operable CPU.

If component failure is so serious that full operation cannot continue, the Executive must decide which functions to perform and delete. It is conceivable that the type of failure would determine which tasks would be performed; however, in general, selecting the tasks to be retained would be done: 1) on the basis of the predetermined priority associated with each task, or, 2) by shifting some of the tasks normally performed at the multiprocessing CPU to the off-line computers, or, 3) by a combination of 1) and 2).

Job Accounting

Standard job-accounting and record-keeping programs will be provided. The Executive will account for elapsed time on each CPU and on each I/O device according to the Program (Satellite Project)office. The job accounting code will be provided at the same time as the job request is made. During vehicle-related activity, the vehicle number may serve to correlate to the appropriate accounting code.

PRELIMINARY BRIEF OF EXPECTED RFP FROM AFSSD FOR THE BIRD BUFFER SUBSYSTEM.

PART III - DISPLAY

The Mission Center is currently the central control point at the STC. it is in this center that the switches and displays used to monitor the STC data handling functions are located. This position is operationally manned by six personnel during real time functions. Actions are initiated via voice net to the Bird Buffer subsystem operators and, if necessary, to the SDC operators at the remote tracking sites. The intent of the expected RFP will be to establish direct control of the Bird Buffer subsystem from the display consoles in the Mission Center. Instructions to the remote site computers will pass through the Bird Buffer subsystem and be under control of the Executive Monitor. The voice net will be maintained for emergency communications.

OPERATIONS

A Station Control and Display console (SCDC) will replace the current Mission Center displays. The SCDC configuration will consist of three IBM 2250 Display and Input (DI) devices. The 2250's will not be dedicated but will be provided the capability for "dialing" the information desired for display.

The SCDC will enable the operators of the mission center to perform the following functions:

1) Assess the mission need for particuar telemetry processing modes

2) Configure STC and RTS Computer programs to accomplish the needs expressed in 1).

3) Control all computer processing via the DI keyboard.

4) Monitor all computer-output data display, either in an operational or diagnostic mode.

5) Provide real time data analysis and control.

6) Initiate non-programmed commands which are necessitated due to real time conditions

UTILIZATION

Computer Control. Control of all computer operations may becontrolled by the 2250 input keyboard, as well as the on-line typewriter. (At any time, the 2250 operator can lock-out the on-line typewriter as an input device to the computer).

Display Makeup. Depending on the type of processing to be performed, the CPU will generate display tables and input drivers. The tables may be filled with overlay and/or mission data, and can be selected at any time by any of the 2250 DI's. In effect, there is no dedicated 2250 DI for any operation, and no concrete or unchangeable total display. The operator can build and change the display in real time (within the constraints of the current softwars system) to implement his real time analyses of data and command control decision. Input drivers can be called in real time if necessary to effect computer driven activities (i. e. digital commanding).

Retention of Data. In addition to data display in real time, the 2250 operators will be able to retain summary information on the 2250's, such as Commands transmitted during PASS, or issue instructions for certain data to be retained "Hard Copy" on the shared on-line printer.

Fail Safe (abbreviated) Operation. In the event of failure of one 2250, the remaining 2250 can support the complete station operation in an abbreviated mode. Utilizing the table philosophy noted eariler, this mode may not be a degraded one.

Lockout Feature. Utilizing the 2250 DI's and input driven methods outlined, it is impossible to initiate erroneous commands. Keyboard inputs in the configuration and sequence outlined by the driver will be the only ones accepted, thus preventing the transmission of erroneous commands to the STC or RTS Computers.

DESIGN

The primary design principle employed is to provide the means to adapt the various missions, or increased operational Command and Control requirements through computer program software, rather than through hardware modifications. Thus, with a sufficiency of computer programs the Mission Center operations will be able to maintain real time mission control.

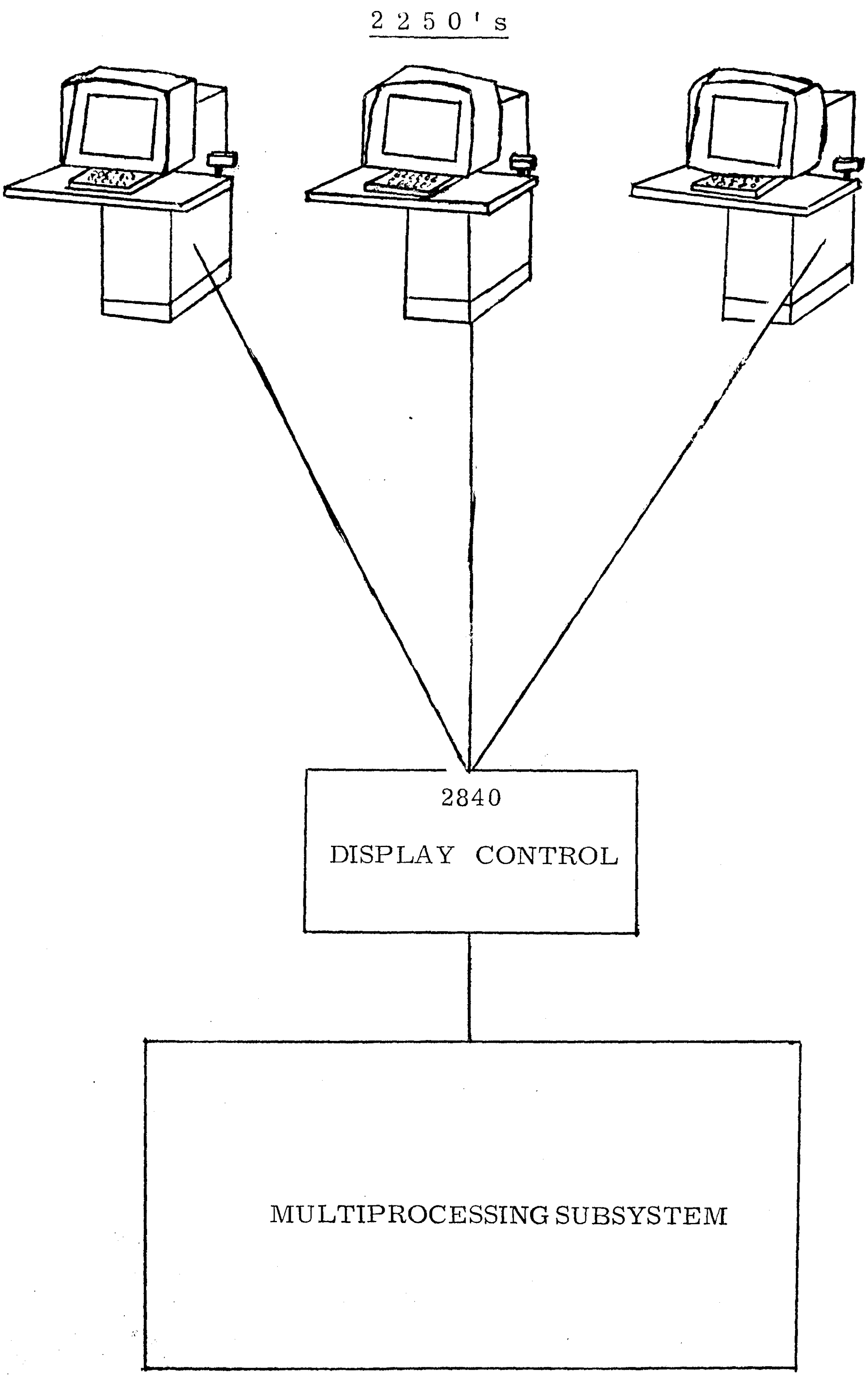
A secondary principal employed is the retention of minimum analog and/or non-computer driven displays to enable "fail-safe" station operation if the entire data procesing system is unavailable. As the "fail-soft" reliability of the total IBM STC configuration is proven, all essential functions of the SCDC could be moved to the 2250 DI's.

IMPLEMENTATION

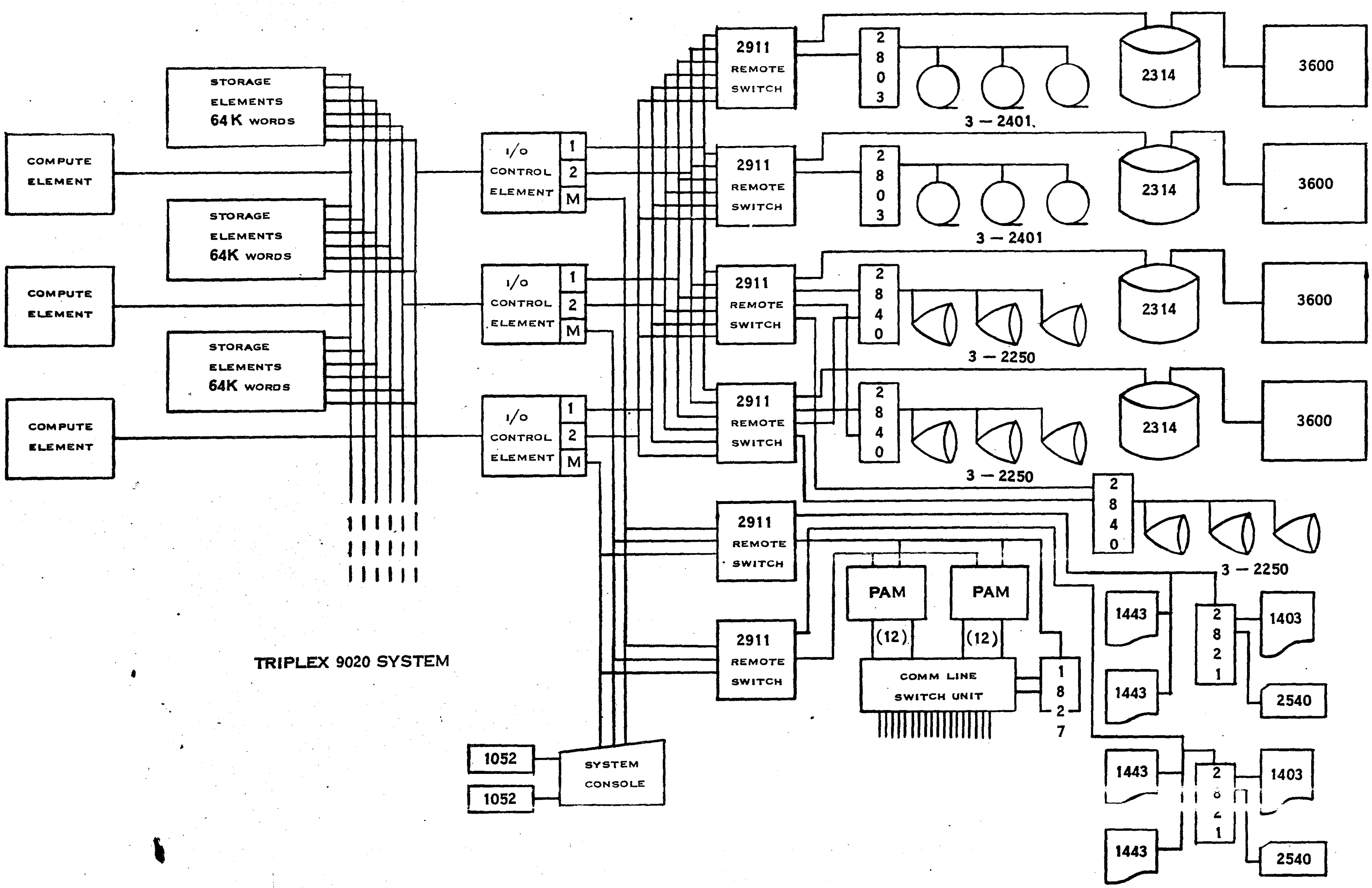
Three 2250 model 2 display units will be located in the mission center. The 2250's will connect to the MPS through a 2840 Display Control unit. (see Attachment I) . The 2840 offers an 8,192 byte buffer in which to store images for regeneration purposes. The use of the buffer allows the display unit to operate concurrently with the MPS, freeing main storage for other functions. The images are transferred from main storage to the buffer only once, thus saving storage cycles and channel time. The buffer is generally used with the character generator and alphameric keyboard to edit or assemble messages before they are transferred to the main computer storage. The portion of buffer storage to be used for any display unit is program-assignable and can be varied in size under program control.

The MPS Connection to the 2840 can be to either a multiplexor or a selector channel. Attachment to the selector channel is preferable, because of the higher data rates.

When the channel is polling for units having status information, the 2840 services the 2250, Mod. 2, units on a priority basis.


2250's
2840
DISPLAY CONTROL
MULTIPROCESSING SUBSYSTEM

SATELLITE TEST CENTER DATA SYSTEM



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Machine Feature	Description	Unit Price	Qty.	MAC	MAC Total
7251-4	Storage Element-64KW-140K	3,500	2	7,000	CPU's etc.
7251-3	Storage Element-32KW-74K	1,850	0	0	41,825
7201-1	Computing Element-190K	4,750	4	19,000	x 115%
7231-2	I/O Control Element-211K	5,275	3	15,825	48,098
2911-x	Switching Unit	800	6	4,800	Switching
2925-x	Switching Unit	1,500	1	1,500	Units
RPQ	Include CCR's in 2925	500	1	500	6,800
2814-2	Display Switching Unit	125	1	125	Displays
2840-1	Display Control	1,100	5	5,500	
3351	Display Multiplexor	50	5	250	
1003	Absolute Vectors	125	5	625	
1499	Buffer (Add'l 8K for 16K total)	400	5	2,000	
2250-2	Display Unit	350	15	5,250	
1001	Absolute Vectors	225	5	1,125	
1245	Alphameric Keyboard	50	15	750	
4875	Light Pen	75	5	375	
5855	Prgmd Function Keyboard	100	5	500	16,500
2803-1	Mag. Tape Control	650	2	1,300	Mag. Tape
7125	7 Track Compatibility	50	2	100	
6148	Remote Switch Attach	n/c	2	0	
2401-2	Magnetic Tape Unit	485	6	2,910	4,310
2314-2	Direct Access Storage	3,500	3	10,500	Disk
8170	Two Channel Switch	140	3	420	10,920
2821-1	Printer Control Unit	970	2	1,940	Printers,
1990	Column Binary	100	2	200	Readers,
1443-N1	Printer (240 LPM)	875	4	3,500	Consoles
1403-N1	Printer (1100 LPM)	900	2	1,800	
2540-1	Card Read Punch	660	2	1,320	
1052-7	Printer-Keyboard	65	2	130	
7265-2	System Console	1,200	1	1,200	10,090
7289	Peripheral Adapter Unit	3,000	2	6,000	Comm.
RPQ	Binary Sync Data Adapter	100	24	2,400	
RPQ	TTY Adapter	100	8	800	
RPQ	1052 Adapter	100	1	100	9,300
1827	Data Control Unit	190	1	190	Voice Line
3289	Dig-AnaOut-Basic	70	1	70	Switching
3296	Dig Out Control	15	1	15	
3295	Dig Out Adapter	15	3	45	
3612	Eco Grp of 16 Pts	20	10	200	
RPQ	Voice Line Switch Box	300	1	300	
RPQ	Voice Line Adapter	20	60	1,200	2,020
					108,038

UNIVAC COMPETITION FOR BIRD BUFFER
Equipment Priced is Rough Equivalent of
9020 Configuration on Page C.2/25 and 26

UNIVAC 494

The attached price list represents a UNIVAC 494 Multiprocessor configuration. The 494 memory is limited to 5 ports which can accommodate any combination of processors and/or I/O controllers. Channels are standard with the processor but may be ignored in favor of the I/O Controller. This configuration, therefore, represents a 3-processor, 2-controller configuration with sufficient two-way switching on the I/O components.

UNIVAC 494

Characteristics

Storage:	16 to 131 K words
Cycle Time:	750 ns/word (375 ns/wd overlap)
Word Length:	30 binary bits + 2 parity bits
Channels:	12 - 250 KC standard (max.24) 555 KC available. No peripheral addressing, one device per channel.
Instructions:	D.P. Fixed and Floating-point and Decimal are standard
DASD Storage:	Various Drums - 2311 and 2321 offered.
Addressing:	15-bit addressing to a 32K bank, relative Index Register designates active 32K bank Half-words are addressable.
Memory Protect:	Standard in 64-word increments
Instruction Times:	

Add	750 ns
Mult.	7.3 us
Divide	7.4 us
Flt. Add	3.2 us
Flt. Mult.	12.5 us
Flt. Divide	13.0 us

UNIVAC 494

Machine Feature	Description	Unit Price	Qty	MAC
5010-01	Card Control & Synch	750	2	1,500
0706-00	Card Reader, 800/900	380	2	760
0600-00	Card Punch, 300 CPM	665	2	1,330
8120-02	Printer Control & Synch	750	2	1,500
0751-00	Printer, 700/922 LPM	800	4	3,200
0900-05	Comm. Term. Module Cont.	650	2	1,300
0901-04	Low Speed Line Adapter	60	4	240
0903-02	High Speed Line Adapter	90	12	1,080
2250	EQUIVALENT DISPLAY			16,500
1827	VOICE LINE SWITCH EQUIV.			2,000
5008-16	UNISERVO VIIIC Control and Synch	1,450	2	2,900
0859-00	UNISERVO VIIC	800	6	4,800
3012-99	Processing Unit	9,500	3	28,500
7005-95	Memory - 131K	20,000	1	20,000
0xxx-02	I/O Controller	4,000	2	8,000
F0xx-08	I/O Chan. (Add'l 4)	500	4	2,000
0xxx-00	Multi-Mem Adapter Basic	500	4	2,000
0xxx-01	Multi-Mem Adapter Add'l.	235	4	940
0955-02	Multi-Processor Adapter	425	6	2,550
7304-01	FH-880 Drum	2,000	1	2,000
8103-03	FH-880 Control & Synch	1,420	1	1,420
2314-2	EQUIVALENT DISK			10,920
				115,440

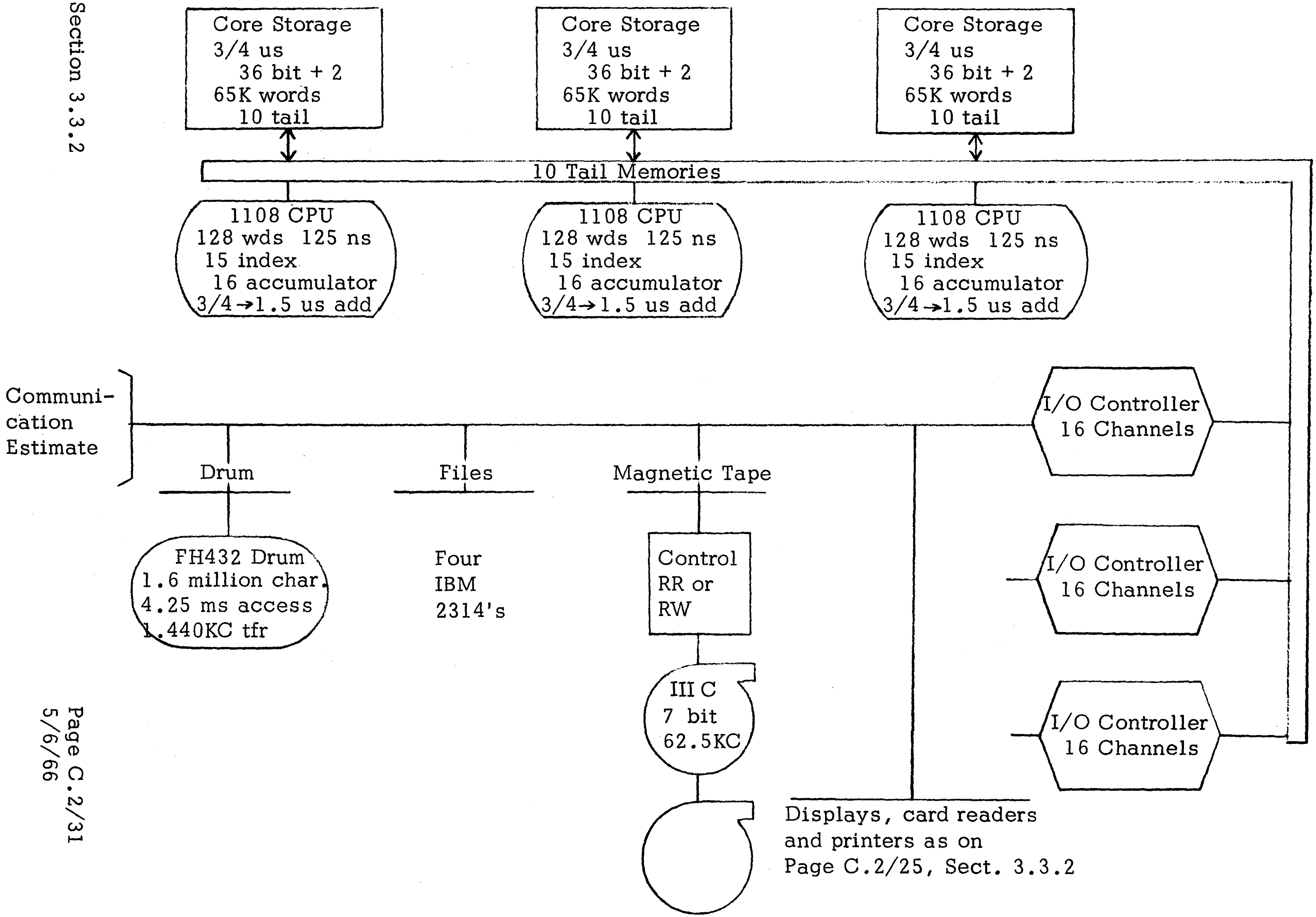
UNIVAC competition for Bird Buffer

Equipment priced is rough equivalent of 9020 configuration on page C.2/25 and 26.

UNIVAC 1108

The attached represents a triplex UNIVAC 1108 multiprocessor configuration. UNIVAC has an 1107 and one 1108 installed at Lockheed Missiles for a security project associated with the Satellite Control Facility. We estimate that this system has roughly six times the potential performance of the 9020. We have used IBM 2250's and 2314's on Sperry's equipment, since they have an IBM standard interface.

1108 CONFIGURATION FOR BIRD BUFFER



Qty.	Description	Unit Rental	Total Rental	Unit Purchase	Total Purchase
3	1108 CPU's 3011-99	$15,500	$46,500	$651,000	$1,953,000
3	Core Stg. 65K wds, 2 banks	10,000	30,000	420,000	1,260,000
3	Basic I/O controller & 4 ch.	4,000	12,000	168,000	404,000
9	Additional I/O channels (4)	500	4,500	21,000	189,000
3	Multimemory adapter (5 tails)	500	1,500	21,000	63,000
3	Additional memory tails	235	675	9,870	29,610
3	Drum (FH432) & controller	3,000	9,000	120,000	360,000
2	Uniservo IIIC tape controls	1,350	2,700	64,800	139,600
6	Uniservo IIIC tapes	750	4,500	36,500	219,000
2	High speed printer controls	750	1,500	34,275	68,550
4	High speed printers	800	3,200	36,000	144,000
2	Reader/Punch Control	750	1,500	33,750	67,500
2	800 CPM readers	380	760	15,200	30,400
2	300 CPM punch	665	1,330	26,600	53,200
(Est.)	Multiple I/O interfaces to three I/O control units	--	2,000	--	84,000
	SUB TOTALS		121,665		$5,064,860
	Displays	--		11,325	
	IBM 2250's & 2840's from page C.2/26				
3	SR 2840 adapters	300	900	13,500	40,500
4	IBM 2314's	5,250	21,000		
4	Two channel switch	140	560		
4	SR 2314 adapters on 1108	300	1,200	13,500	
	Communications				
2	0900-05 comm. terminal cost	650	1,300	25,000	50,000
4	Low speed line adapters	60	240	2,400	9,600
12	High speed line adapters	90	1,080	3,600	43,200
	TOTALS	$45,970	$147,945	$1,727,320	$5,208,160

D. PROBLEM AREAS

Resolution to the security of classified data at the Bird Buffer installation is a problem. The following paper has been submitted to Aerospace/SSD as a possible solution.

THE SECURITY OF INFORMATION IN A MULTIPROCESSING SYSTEM

12 November 1965

IBM CORPORATION, LOS ANGELES, CALIFORNIA

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INTRODUCTION

When secure information is to be processed in a multiprocessing system, the historical methods of achieving the necessary security via isolating the various programs and data by physical equipment separation can no longer be applied. By its very nature, a multiprocessing system implies commonality of equipment and sharing of acilities. This centralization of computing equipment does not, however, mean that the security of the information to be processed in such a facility will be compromised. The architecture of IBM's System/360 permits the establishment of a combined hardware/software system design which will provide the requisite security while retaining the advantages which accrue from multiprocessing.

During the design of System/360, the need for assuring the security of data and programs was recognized. The primary reasons were to obtain privacy of data and records where needed, and to permit the testing of programs by restricting them to specific regions of memory, thereby precluding accidental or deliberate destruction of other data during the testing period. Two primary techniques were built into System/360 to answer this need:

1. Instructions which cause a change in system status or the system control parameters, which alter storage protection arrangements, or which perform input/output operations, are considered privileged. These instructions may be performed only by a processor designated as being in a supervisor mode.

2. All core storage attached to the system has a storage protection feature. This feature always operates. It precludes access to any storage location without presentation of the proper storage key. The assignment of storage keys can be done only by privileged instructions executed by a processor in the supervisor mode.

These techniques will be examined in greater detail. It will be shown that a secure environment can be established for the processing of classified information in a multiprocessing system.

THE PROGRAM STATUS WORD AND PRIVILEGED INSTRUCTIONS

The Program Status Word (PSW) is a fundamental part of the architecture of System/360. The PSW is contained in each computer. It is the storage register for various types of control information which reflects the status of the system and the conditions under which a program is being executed. Two items in the PSW are of particular interest to this discussion, the supervisor bit and the storage key.

Each computer operates in either the supervisor state or the problem state. The state is specified by the supervisor bit in the PSW. When it is in the problem state, the machine can execute all necessary computing and data processing-type instructions. However, instructions which have to do with I/O, storage protection, or instructions which can alter the control fields of the PSW are privileged instructions, and are not valid when the machine is in the problem state. An attempt to execute one of these privileged instructions when in the problem state will result in suppression of the instruction and an interruption to a supervisor program.

Each time a reference is made to core storage, the computer must present a storage key for access. (The details of the operation of storage protection are covered in a later section of this paper.) The storage key used by the computer is that one which is contained in the PSW.

Once a PSW has been established, the computer is restricted to a specific region of storage (defined by the storage key) and operates in either supervisor or problem state as specified by the PSW. The computer will remain in this status until the PSW has been changed. A PSW can be changed in only three ways:

1. Through the use of computer instructions. Each instruction which can change the supervisor bit or storage key, however, is a privileged instruction. A computer must be in the supervisor state to execute these instructions.

2. By a program interruption. A program interruption is accomplished by replacing the current PSW with a new one. This new PSW is fetched from a specific area of storage called the Preferential Storage Area.

In practice, this area of storage is used only by the supervisor program and would be under a storage key reserved only for the supervisor's use. Thus, a machine which does not have the proper storage key in its PSW could not enter that area of storage to modify a PSW to be fetched on a subsequent interruption.

3. By an initial program loading operation. The initial program load is done from a control console. When exercised, it places in the machine a new PSW which will then control the system until the program being read in changes it. This PSW is obtained from the input device used for loading. This presents no hazard to security of data since there are two controls. First, the recording medium used on the input device can be controlled. Second, the actual operation of the loading function can be placed under console lock and key, and the key retained by a designated authority.

Thus, modification of the PSW, which is vital to the establishment of a secure data environment, can be rigidly controlled. Users operating in the problem state cannot modify their PSW to permit unauthorized access to compartmented data, or to permit execution of privileged instructions.

STORAGE PROTECTION

For the purpose of storage protection in System/360, all of core storage may be considered to be divided into blocks of 2048 bytes (byte = 8 bits plus 1 parity bit). These blocks are located on address boundaries which are multiples of 2048. With each block of 2048 bytes, there is associated one of 16 possible storage keys which are contained in a separate part of the storage unit.

Whenever a reference is made to a storage location, the accessing element must present a storage key along with the address. The storage unit will read out the storage key associated with the block which contains the referenced location. A comparison is made between the key contained in storage with the key presented by the accessing element.

If the accessing element wishes to alter the referenced location, then the keys must match. If they do not, storage protection is violated and a program interruption to the supervisor program occurs. The data in the referenced location is not altered. The execution of the instruction or I/O operation is suppressed or terminated.

If the accessing element does not wish to alter the location in storage but only wishes to read it, an option is available. At the time that the storage key for the location was established by the supervisor program, the key could be set to specify "fetch protection" also. If the key in storage is set for fetch protection also, the key presented by the accessing element must match the storage key or protection is violated for a read operation. Again, for this situation, a program interruption to the supervisor program occurs. Data from the referenced location will not be transferred to addressable locations in the accessing elements, nor will it be written on any output medium. This option on protection for reading of data permits either total protection (read or write protection), or the flexibility for sharing of areas where it may be desirable for several programs to read some common data without allowing alteration of that data (write protection).

A "master key" (specifically zero) is provided for use by the supervisor program. Such a capability allows the supervisor to alter or override storage keys to restructure the storage area.

The storage keys contained in the storage unit each have a parity bit associated with them. The keys presented by accessing elements are also protected by parity bits. Single failures in either the accessing elements key or the storage elements key will be detected and signaled. Interruption to the supervisor program is done immediately on detection of these failures.

The storage protection in System/360 thus permits the isolation of data and programs in storage under a unique storage key. Access to this area is not possible unless the correct key is presented. Single failures of the equipment will be detected to preclude the possibility of an incorrect key being altered by a failure to a correct key.

A SYSTEM CONFIGURATION DESCRIPTION

A more cohesive understanding of the handling of secure data in a multiprocessing system can be gained from an examination of an actual system configuration. Figure 1 is a block diagram of a system which could be used for real-time data processing with varying security and need-to-know requirements. The system shown in Figure 1 is, of course, only one form that a multiprocessing system could take. Each element in the computing system is duplicated, providing a back-up capability in the event of an element failure. The modularity of the system permits other units (storage, computer, or I/O) to be added should an increase in capacity be required. Figure 1 has omitted for clarity any of the conventional I/O devices such as tapes, disks, printers, etc. These may be attached to the I/O control units as desired.

The computing elements provide the computational and data processing capability for the system. In addition, the computing elements provide special facilities for system control. Storage is provided in modular units. The interface with the peripheral devices and communication links is provided by the I/O control units.

The computing elements do not have I/O capability. All I/O operations are initiated by a computer which informs the I/O control unit of the type of I/O operation desired and the device it wishes to activate. The computer then proceeds with its normal instruction stream. The I/O control unit performs all data routing and control functions necessary to perform the I/O operation. Each I/O control unit can access any location in the storage complex, as can each computing element. I/O operations are also monitored by the storage protection hardware.

Multiprocessing offers the ability to program a system in a very flexible manner. Since there is complete symmetry in the system, i.e., the computers are identical, all storage is available to all accessing elements, etc. To achieve the potential benefits of multiprocessing, the computing elements would not be "dedicated" in the sense that each one always performs a specific function. The preferred approach is to treat computers merely as resources. Each is assigned the next task in the problem as it becomes available.

Such a concept requires the symmetry of the system shown in Figure 1. With this approach, any user may avail himself of the complete resources of the system. Also, the modularity of the equipment makes growth a relatively simple problem. If system programs are written initially to take cognizance of the system resources available and to operate accordingly, then an increase in resources will cause no great inconvenience to established programs.

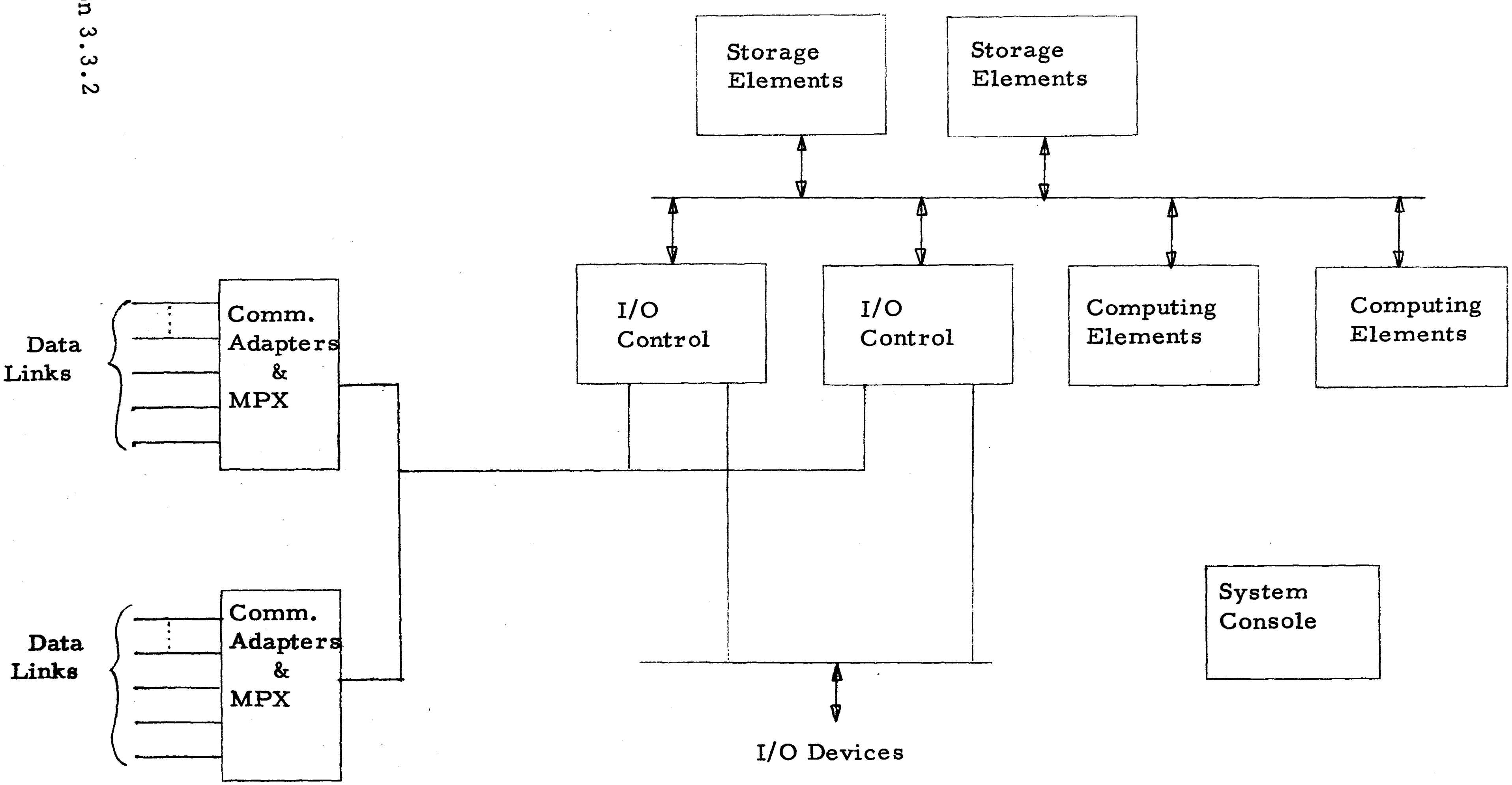


Figure 1. A Multiprocessing System

PROCESSING OF SECURE DATA

The foregoing discussions on the various aspects of assuring the security of data in a multiprocessing environment can be best appreciated in the context of a hypothetical procedure which could be used. A procedure will now be discussed which will show how these various features can be integrated.

It is presumed that data is being received from the communication links and that the data from each source must be isolated into data groups and protected. There may be several of these communication links active at one time. It is also assumed that separate problem programs will be used to manipulate and process each data group and that these programs will in general be allowed access to only that data group which is of specific interest to it. It is further assumed that there may be occasions where it is desired that a problem program have access to several data groups.

Control of the entire system would be vested in a supervisor program. This program would perform the following functions:

1. Structure storage and allocate system resources for each user program.

2. Schedule and dispatch task programs.

3. Respond to all inquiries from terminals concerning access to stored data and requests for specific programs to be run.

4. Execute and control all program interruptions.

5. Perform all input/output operations.

This supervisor program would be resident in one storage unit. Either unit could be used. To preclude a system breakdown in the event of a core storage failure, the supervisor program would also be stored on an off-line medium (disk, tapes). To enable quick recovery, a bootstrap calling sequence would be retained in the alternate core storage unit. Thus, in the event that a core failure is encountered, provision is made to automatically interrupt into the alternate core storage to begin recovery operations.

All supervisor program space would be protected by a unique storage key. At the time of initial program loading, the first task of the supervisor program would be to structure the necessary supervisor storage areas with the storage key specified. From that point, only a program with this key can operate in those areas. This key is never assigned to any program except the supervisor.

From the time of initial program loading (when a specific computer is assigned to perform the load) the supervisor may be run by either computer as needed. This is an important concept of multiprocessing. The control is really the program. The actual machine which executes it will vary from time to time. This presents no security problem, since a machine must execute a program interruption to run the supervisor program. The interruption service programs are, in fact, a part of the supervisor and are stored under the supervisor key. Hence, a machine cannot gain access to this area while in the problem state. The supervisor program should be largely re-entrant (i.e., no modifications of the program should be permitted) to minimize the need for control of sequential execution by both machines.

The supervisor would establish distinct areas in core for use as buffers for incoming data. Each buffer area would have a separate storage key specified by the supervisor program. The actual keys to be used by the supervisor could be controlled as closely as desired. A standard set could be used which are always loaded along with the supervisor program. Alternatively, these keys could be entered by a designated authority at a supervisory terminal on the system console whenever it is desired to alter the key arrangement. The necessary procedure for entering these keys can be made sufficiently complex, requiring the interchange of various recognition signals in a prescribed order, that no possibility of subverting the key structure can be imagined.

When data appears at a data terminal, the I/O control portion of the supervisor will service the I/O interruption. It will then store the data in the area reserved for that data group, using the proper key.

When a task program is scheduled to operate on the data group, the supervisor will establish a residence area for the program which will have a key identical to that of its data group, establish a PSW for the task program which specifies the proper key, and establish that the task program will operate in the problem state. The task program will then be initiated.

Output of data through the communication links would be essentially a reversal of the above procedure. Data would be assembled in a keyed area by the task program. The task program would request that the supervisor program perform the output operation. The supervisor would then initiate the output via a specified communication line, and restrict the output to the area under the key protecting the data group to be transmitted.

Should the task program legitimately require access to data other than that under their key, they can request that their key be changed by the supervisor. This would, of course, require that the request contain sufficient recognition signals to validate the need-to-know, or that the supervisor be programmed to honor these requests, knowing in advance of the data requirements of each task program.

The system can be constructed to permit as much security as required when responding to requests for access to data or operation of programs from terminal devices. Recognition sequences is one technique which is feasible and readily amenable to periodic variation to enhance security. Also, the operation of terminal devices can be under physical lock and key.

This brief discussion of a hypothetical operating procedure could not answer all detailed questions on each facet of assuring security of information. It should be clear, however, that there are manifold possibilities for various security techniques which can permit the uncompromised use of classified data in a multiprocessing environment.

ADDITIONAL CONSIDERATIONS

The system shown in Figure 1 has the capability for providing considerable additional protection should it be warranted. There has been implemented on some IBM systems a technique known as configuration control which will permit electronic partitioning of the system and isolation of the subsystems thus created.

In the essentially duplex arrangement shown in Figure 1, this configuration control will permit a very flexible partitioning of the equipment into various structures. Some of the possibilities are:

1. Completely isolated "simplex" systems. This partitioning would result in two separate computer systems, each containing one of each type of element shown. If it was felt necessary, these can be operated as entirely unrelated computing facilities.

2. Blocking access to various elements. It would be possible to completely inhibit one or both storage elements from being accessed by one of the computers or I/O control units. It would be possible to assign control of both I/O control units to one computer, thereby precluding any I/O operations from being initiated by the other. These interface controls are designed to be operated primarily by a supervisor program, although manual partitioning under physical key control can also be done. Aside from providing an additional level of security when required, this configuration control mechanism offers extremely important advantages for maintenance and program testing.

Effective maintenance on a computing system requires the use of diagnostic programs designed to exercise the failing equipment and isolate the malfunctions to small equipment areas. In the course of this exercise, errors will be stimulated to test the equipment. The configuration control technique permits the failing element, along with other elements required to run the diagnostic program, to be isolated from the remainder of the system, while this repair is being' performed. Thus, errors in the failing equipment under repair will not be propagated to the remainder of the system.

When newly written programs are to be installed, it is desirable to test them in as realistic an environment as possible, yet not allow them to interfere with the operation of the working system. An isolated subsystem could be established with configuration control to allow such program testing to be done at slack times.

The capability afforded by the partitioning mechanism can be employed for additional security where it is considered necessary. It also enhances the flexibility of the multiprocessing system. As the system matures, it may be desirable to add additional modules of storage, computers or I/O control. Automatic replacement of failing elements with spares then becomes possible, thereby greatly extending system reliability.

BIRD BUFFER TASKS

A. EQUIPMENT

1. Develop the following shared memory system:

   360/65
   360/44
   9020

2. Justify selection of all system equipment and features, especially memory size, redundant I/O channels, etc. Include a tradeoff study of 2700 series, 2900 series vs. PAM. for comm. links at 1200 bps and TTY, 40.8 kbps.

3. Determine for each type system:

   a) I/O interference for each I/O channel and/or unit
   b) Availability of hardware diagnostics
   c) Channel arrangement of I/O, priority on channels, status conditions to be recognized, size of word blocks,
   ' existance of timing problems on shared subchannels and channels.
   e) System reliability and availability.

4. Develop for inclusion in proposal:

   Description of internal data flow for each machine
   Description of any special features including channel RPQ's.

5. Prepare DPOWS and RPQ's which may be required.

6. Develop input/output voltage level, current and impedance characteristics of non-IBM interfacing equipment.

7. Develop recommendations for system grounding.

8. Determine applicability of DOD Spec. FS222.

9. Design interface and data flow for 1301 or other applicable disk and 3600.
   a) From descriptions of Mission Center and MOL-Bethesda inputs recommendations for 2250 application.
   b) Determine the number of consoles and control units by area, include buffer storage requirements.

Bird Buffer Tasks (continued)

10. Develop formats for I/O words to and from non-IBM interfacing equipment; i. e. expand from 12 bit interface to 16 or 32 bit interface.

11. Determine any potential effect of equipment and format changes in STC on RTS operational procedures, programs and equipment, e. g. STC-Site communication message formats.

12. Ensure system compatibility with Systems Assurance Provisions.

B. PROGRAMMING

1. a. Develop inputs from MOL-Bethesda group for MOL impact on STC.
b. Verify and describe in greater detail the operation of Multi-processing Executive monitor including its operation at initial load, with task scheduler, under various conditions of program error or machine failure.

c. Determine utility of FAA-Operational Error Analysis Program.

2. Identify software applicable from standard systems, time-sharing and FAA.

3. Develop recommendations for tracking, command and telemetry processing conditions; i. e. sequence, algorithm selection, timing, table size, table design, etc.

C. APPLICATIONS DEVELOPMENT

1. Expand use of 2250 display in:

a) Commanding
b) Observing TM data points and trends
c) Controlling and diagnosing center operation
d) Overseeing site operations and communications in the pre-pass, pass and postpass modes.

Bird Buffer Tasks (continued

2. Show applicability of 360 instructions in processing TM data; analyze requirements for special TM instructions, such as those used in WSMR-TDC proposal.

3. (a) Develop use of the STC computers for RTS equipment and software configuration control; (b) STC diagnostics and checkout, including a diagnostic that checks computer interface equipment, then all the way through communication paths to sites.

4. Implementation Plan

5. Maintenance Plan.

6. Others to follow. (See attached amendment)

Amendment to Bird Buffer Task

Assignments

C-6. Develop method(s) for maintaining secure data requirements in multiprocessing configuration through software control. Examples of methods to consider:

1) data coding and storage/processing allocation under EM Control.

2) Encrypting and decrypting programs for internal CPU use.

3) Computer mode switching to change from a true multi-processing configuration to a stand alone configuration whenever "very sensitive" data handling requirements are dictated.

Functional Interface

User interface with System/360 consoles, the 2250, 2260, 1050, 2740, 2741, is completely a function of the programming in the host CPU. In the use of the fully buffered units, the 2250 and 2260, data is displayed from or intered into a buffer, which is read/written by the processing unit. The printer-keyboard type units, 1050, 2740 and 2741, are character buffered by a control unit directly under the control of the host processing unit.

Application Interface

In the anticipated application of the 2250 to the display function at the STC, the console/user interaction is described as follows:

> To initiate a mission support request, the user will request service by entering a vehicle number and an individual need-to-know identifier (perhaps assigned to each user separately or to each MCC as an entity). This request will then be honored if the identifier is acknowledged valid; otherwise, service would be denied and the details of the request logged at the Systems Control Center. (As a precaution, all transactions of this type should be logged in a similar fashion.)

Because of the interface structure, hardware and software, between the console user and the processing unit, it is impossible for the user to gain access to secure information without the cooperation of the controlling programs. There is the very low probability that a memory failure, data transmission failure or data recording/retrieval failure might occur singly or in combination without detection by the error checking circuits of System/360. Moreover, it would be virtually impossible to take advantage of the failure because of its typically random characteristics.

Software Interface

Modification of the operational programs or their verification tables to permit unauthorized access has to be accomplished by patching/changing of the existing code, by manual entry at the system console, or by integral design into the operating program. The first two methods are controllable through operational security techniques such as placing the program residence device as well as the system console under lock and key access, forcing direct monitoring of the programming maintenance/change function. The latter approach requires in-depth knowledge of the program design and integration of dynamic program modification techniques into the software without detection, both requiring a collusion from conceptual design through acceptance test. However, to be effective, such a technique must be instantly cognizant of storage protection assignments. Because the protection scheme is dynamic and can be varied in any arbitrary manner, it would be difficult, if not impossible, to manipulate code which itself is protected. Further, the key area in each processing unit, locations 0-4095, could be protected further with lock and key control over the storage protect function, making this area virtually execute-only storage.

Data Input and History Recording

The Input/Output devices of System/360, in this case specifically the 2702 Data Communications Control, the 2311 or 2314 Disk Files, the 2400 tape drives and the 2250 display units, are extremely flexible in that they can input/output from anywhere in storage under program control. Two approaches exist which enable secure paths to be established between the processing unit and the I/O device. First, hardware registers constraining selected units to unique storage blocks could be implemented. The initialization of these registers could be accomplished by special CPU instructions executed under lock and key control. The alternate approach utilizes the program and data protection as described in the previous section. Input/Output tables tying peripheral devices to storage assignments and the I/O supervisor itself could be located in lower memory, which is restrained to an execute-only mode.

Summary

It appears that total data security is possible with System/360 subject to the very low probability of undetected hardware failure and the always-present possibility of collusion. An extension to the standard System/360 write-protection capability along with the RPQ read-protection feature appears to be the most effective means of control while still retaining full compatibility with all System/360 processing units.

# # #

This paper delineates the software committed or currently available with the 9020 system as contracted with the Federal Aviation Agency. This software capability is divided into three categories. The Diagnostics and Diagnostic Monitors which are delivered under the hardware contract, the Utility Programming System which is delivered under the hardware contract, the Operations Supervisor which is delivered under the software contract, and the Operational Error Analysis Program, a unique real-time, on-line diagnostic program. It appears that the software committed under the hardware contract is readily available for use at the STC. Additionally, the software which would be applicable and was committed under the software contract to the FAA would be available through government channels to the STC.

The following is a brief description of each of these pieces of software and their current application. The addendum to this document delineates the size of each of the pieces of software and the estimated percentage of applicability to the Satellite Test Center.

OFF-LINE DIAGNOSTIC PACKAGE

The Off-Line Diagnostic Package consists of the system and component diagnostics as individual packages integrated under various levels of a diagnostic monitor. These diagnostics are an extension of those delivered with present stand-alone IBM hardware systems. There are basically five levels, under a comprehensive monitor. Diagnostic analysis begins with a monitor loaded under the initial program load condition to test the ability of the system to execute basic instructions and extending through the highest level diagnostic which fully exercises the 9020 as a multiprocessor system. This last monitor was developed in support of the multiprocessor configuration and is an extension of the normal diagnostic support offered with IBM systems. The unit diagnostics furnished with the diagnostic package consist of three levels. Starting at the most basic level, the Fault Locating Tests (FLT) test and diagnose the IOCE's, CE's and memories and isolate errors or malfunctions to a small number of component circuit cards. The second level of diagnostics is the Unit Functional Test Diagnostics which exercise each unit to determine if it will perform according to its functional specifications. The highest level of diagnostic routines furnished is that which tests the system as a whole. These are the diagnostics which examine the system for the operation of the multiprocessing instructions and exercise interfaces between the various elements in the system.

This level of diagnostic support for the 9020 also includes the ability to dynamically exercise the system in a scheduled fashion for extremely long periods of activity on all components of the system. This ability, the Systems Evaluation Technique, or SEVA, allows for reliability checking and acceptance tests.

These diagnostics do not include support for disks, displays or other adapters in the STC configuration.

UTILITY PROGRAMMING SYSTEM

The Utility Programming System includes a monitor and programs for the production of application software. In capability, it is analogous to current systems such as the IBSYS System on the 7094 or the Operating System on the 1410 system. The Utility Monitor is a single-job, single-task, batched-processing system. It runs on the 9020 using a single compute element, a single input/output control element and a minimum of two storage elements for compilation. It will run in a single storage element, and if more than two are available, it will use this additional capability. The following capabilities are included in the Utility Programming System. The JOVIAL Compiler at the J-2 level operates under the utility monitor. A Basic Assembly Language Translator is provided for machine language programming. Typical utility functions including a trap-trace program, a core-dump, file-dump and a loader for relocatable code. An editor is provided for the maintenance of the utility tape for the addition, correction and deletion of the components of the utility system. Other capabilities include a symbolic maintenance program, enabling the application programmers to maintain and update Symbolic Programs on tape. An application library, usable through either JOVIAL or BAL is provided for those common routines such as mathematical functions which are required in the application.

The Utility Programming System, as provided to FAA, is a tape-oriented programming system. It appears that for the STC the systems design would be desirable to alter it to reside and utilize disks.

OPERATIONAL SUPERVISOR

The Operational Supervisor is the real-time monitor required to control the application tasks. It is general in nature in that it provides the services required for operation and control of the 9020 system. These services include the supervision of the interrupts including input/output, supervisor call, program exception, external and timer interrupts. The machine check interrupt is the primary interface to the Operational Error Analysis Program. Input/Output supervision is provided for those devices included in the FAA 9020 systems design. The Supervisor is designed to operate most effeciently in the real-time environment, expediting the handling of the real-time interfaces such as communication lines and displays.

- more -

OPERATIONAL ERROR ANALYSIS PROGRAM

The Operational Error Analysis Program provides the system with a real-time, on-line diagnostic capability. OEAP is initiated via the machine check interrupt in the Operational Supervisor, external interrupts from other components of the system, or via program interrupts caused by storage address errors. The OEAP provides real-time analysis of system failures and attempts to pinpoint them to a component within the system. Not only is this failure pinpointed, but also the OEAP program will then reconfigure the 9020 system around the failure to continue the real-time support mission of the system.

9020 PROGRAMMING STATUS

Program	(No. of Instr.)	STC Applicability	Available
Diagnostic Monitor System	500,000	100%	Now
Utility Programming System	250,000	100%	Now
Operational Supervisor	6,500	95%	7/66
Operational Error Analysis Program	14,000	100%	1/67

Function	Source	Rate	Type-Ch.	No. Instr.	I/O Interrupts/Sec.	I/O-Mem. (Ref/Sec)	Instruct. (Ref/Sec)
Data Input	RTS TLM	300 B/S	MPX		3.0	300	1350
	2250 Console	----	SEL		.1		45
Data Output	2314-History	300 B/S	SEL		.1	75	45
	2250 Display 4 x 4 Groups per Mission	500 B/Grp/S 2000 B/S	SEL		4.0	500	1800
	2250 Display System Control 4 Displays	150 B/S	SEL		1.0	38	450
Interrupt Handl.	I/O			300[2]			
IOCP	Service			1000[4]			2000
Message Servicing	Input			250[3]			500
Display Formatting and Generation	Output			4000[4]			10000
Intermediate Processing	TLM 4 Console Req			750[1]			1500
History File Gen.	Output			500[4]			1000
CE-IOCE Mem. Inter							
CE-CE Mem. Inter							
Multiprocessing Overhead	Task Ass'mt Sched., etc.			1000[4]			2000
						913	20690
							21603 (out of 400,000)
							5.4%

(1) from 160 code/2.7 (G. West)
(2) Average OS/360 & 9020 OS
(3) G. West
(4) Estimate

NOTES TO 9020 LOADING CALCULATIONS

A single 9020 CE-IOCE-SE string has 400,000 memory cycles per second available for compute and/or Input/Output activity. Instruction execution will always account for a minimum of one memory cycle/instruction (RR class), more commonly two memory cycles/instruction (RX class), and occasionally more (SS class). Input/Output will utilize one memory cycle/byte transferred via the Multiplex channel and one memory cycle/word via a selector channel, plus additional references for data chaining and command chaining.

In the STC application, memory contention between a CE and IOCE in support of a single mission appears extremely low with the IOCE averaging less than one storage request out of 4,000. The CE averages less than one request out of 20.

Extension of this analysis to a 9020 multiprocessor configuration introduces additional loading factors. Overhead execution time will be introduced for resource management. Memory conflicts will occur between the multiple active elements in the system as a function of the memory mapping of the application program. This is tempered in that a single CE retains control of all active IOCE's and will be in certain memory areas more frequently than others. Such a conflict analysis cannot be empirically derived.

January 12, 1966

TO: W. B. Gibson, J.E.Hamlin, J.J.Selfridge.

FROM: R.V.Coalson, W.C.Derango, D.A.Fuchs, G.D.West.

SUBJECT: Trip to Manned Space Center.

On 7 January, 1966, a trip was made to the NASA Manned Space Center for the purpose of obtaining information about the RTCC which might be pertinent to the upcoming RFP for the SCF. In attendance were the above MOL Project personnel and Tom Humphrey, Al Pfaff, Dave Behne, John Mueller, John Bednarcyk, and Bob Kagy from IBM MSC. Information was sought concerning: real time programming, multiprocessing, multiprogramming, conversion to System 360, system diagnostics, management information, and telemetry.

It was believed that Houston would probably be the first area of IBM which would be attempting to adapt OS/360 to a truly real-time situation, utilizing time-sharing, multiprogramming and multiprocessing. Since scheduled switchover to System/360 is scheduled for Fall 1966, system design of a real time monitor, etc., was expected to be fairly well defined. Additionally, new insights into telemetry processing were hoped for, in that the 7094 receives only slightly formatted data from the tracking stations via the UNIVAC telemetry processing system.

Briefings and conversations with Tom Humphrey and John Mueller indicated that the design of the Executive portion of the new 360 system was still somewhat fluid, and pointed out some problem areas they were currently struggling with: a) advantages of a shared memory in a true multiprocessing situation; b) use of Fortran or PL1 in producing multiprocessor systems; c) use of 2250 as a command/control device; d) programming overhead caused by more sophisticated systems. It appears that the first 360 system will be "stand alone" and operate conceptually like the 7094. Multiprogramming and time sharing will be initially employed, but not multiprocessing; this will come later. Complete available documentation on modifications of OS/360 for Houston, and system design philosophy was obtained and discussed.

Telemetry processing discussions with Bob Kagy and John Bednarcyk revealed that the buffering of TLM data from the ground stations to the control center is done by UNIVAC computers and programs. (see Figure 1) These facts, coupled with the low telemetry processing rate, basically indicate that the

IBM Houston real time telemetry processing technol ogy is not as advanced as that of the SCF. Lockheed does near real time processing of telemetry from analog recordings on the CDC 3300, which is more analogous to the SCF operation. Will Derango initiated a luncheon technical discussion with Lockheed concerning this activity on an informal basis. Lockheed personnel felt that the CDC 3300 is an ideal real time TLM processor. In the Houston operation, CDC has included some specialized "TLM" instructions on the 3300 hardware. Current CDC proposal efforts are under way by CDC to upgrade the hardware to a 3800 or "some kind" of 6000 with a verbally promised emulator to process existing 3300 code.

An interesting note on the Lockheed effort is that LMSC Sunnyvale formerly had the data processing contract at Houston and was eliminated, due to NASA dissatisfaction. Lockheed Electronics Corporation, in conjunction with CDC, won the subsequent competiton and proceeded to transfer most of the technical personnel (not management) from LMSC to LEC.

The software system at NASA-Houston is an indication of the present state-of-the-art while the new system design reflects the lessons learned from the present support activity. There is a need to increase the efficiency of computer utilization in the RTCC by means of advanced programming techniques, such as multi-processing. The implications have been explored in design studies and a limited degree of multi-processing has been recommended. However, they are approaching the matter cautiously as it is realized that multi-processing is a gigantic undertaking and is not wholely compatible with the planned System 360 software. Documentation was obtained concerning their present multi-programming operation system. Much of their OS/360 design experience is directly applicable to the SCF.

The approach to diagnostics at the RTCC differs considerably from what is anticipated at SCF, mostly from the difference in operating system requirements. Since the MSC is not under continuous operation, many hours may be dedicated to system checkout prior to vehicle launch, thereby eliminating much of the down time. However, the ground rules seem to be that if a station is down, it stays down until someone gets around to correcting the failure. No requirements for allowable down time have been defined.

Diagnostics at the RTCC consist only of standard available routines, plus a series of tests to determine Go-NoGo status of various system aspects. Fault analysis and correction is done under cognizance of Goddard by an analysis system called CADFISS. This will be investigated shortly.

Al Pfaff supplied a complete description of the new Model 75 configuration. He and Tom Humphrey also had a few comments about the Model 44 system to be proposed - namely, concerning the difficulties involved in programming a multi-processing system.

In a single real-time mission support situation, such as NASA's, the need for a detailed scheduling and configuration control program is not of paramount consideration. In this respect the SCF differs greatly from NASA and will require a unique approach to configuration control and scheduling. However, OS/360, with its associated peripheral equipment, lends itself favorably to methods for solving these operational requirements.

D A Fuchs

D. A. Fuchs.

cc: MOL Project Personnel,
MOL Project Notebook.
DAF:jh

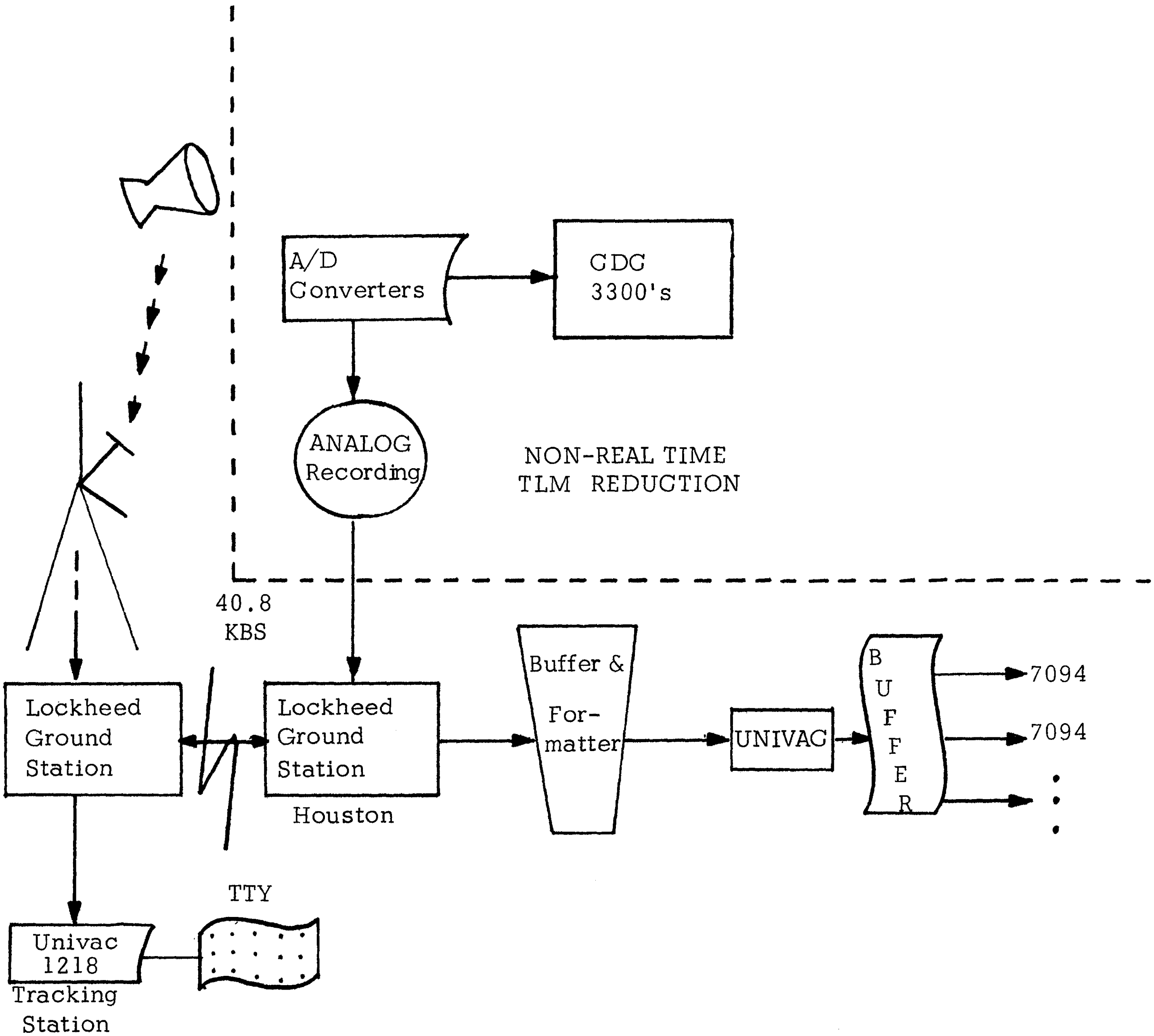


FIGURE I: NASA HIGH SPEED TLM FLOW

LOS ANGELES AEROSPACE BUILDING
Manned Orbiting Laboratory Project

December 30, 1965

TO: Mr. J. J. Selfridge

TRIP REPORT TO AFSCF, SUNNYVALE, CALIFORNIA

Messrs. Mort Needle, Robin Mowlem and myself visited the Satellite Control Facility at Sunnyvale on December 22, 1965. The purpose of the visit was to secure as much information as possible about the present SCF configuration, operations, and personnel and to ascertain planned growth commensurate with increasing support requirements.

The following persons were visited:

Lt.Col. N. Alton, Chief of Operations (ACES)
Lt. W. Kirsch, Facilities (ACES)
Major Reed, Chief Multiple Operations
Lt. Col. McCleary, Chief of Data Analysis
George Hurlbut, Lockheed - Chief of SSOTC
Bill Pollard, SSOTC
Bill Braswell, SSOTC
Lockheed Mission Support Personnel - MCC

During conversations with the above personnel, the following information was obtained:

1. The Lockheed Configuration Planning Group (SSOTC) has recommended to the Air Force five possible modes of operation for the IBM 2250's to be leased. The modes are:

a. Operation as a printer
b. Selection of one of several formats using mode a.
c. Graphic
d. Remotely operating the Bird Buffer computers
e. Recall of data for history.

It is very likely that mode a. will be adopted since the processing time of the 160A constrains the amount of processing and/or formatting that can be accomplished in each data cycle. Extensive use of the 2250 in other than mode a. will cause the loss of data from the incoming 1200 baud lines. Although the use of 2250's with 160A computers severely restricts the 2250's capabilities, this situation strengthens our proposed bid for replacing the 160A's with System/360 computers. This is especially true since the SCF's requirements for display requires the full utilization of 2250 capabilities.

2. The Bird Buffers are not dedicated to particular missions as we thought, rather each Bird Buffer is dedicated to a particular remote site. Data from all birds which are supported by a remote site pass through the Bird Buffer dedicated to the site. This means that data security is not a paramount consideration in the Bird Buffer Subsystem (as the system is being used). Lt. Kirsch stated that the only area in which data security is assured is in the off-line 3600's; however, when the Bird Buffers are supporting one of the very sensitive birds, the Bird Buffers can be configured to assure hardware isolation for the data. (This unique support configuration is used whenever dictated by the SPO office personnel.) At present, only two such birds are so supported.

3. According to Lockheed, there are three types of data in the STC.

<u>Systems Data</u> (Management status)

Users: a. Multi OPS
b. Data Systems Director
c. Systems Controllers

<u>Telemetry Data</u> (Dynamic status)

Users: a. Data Display
b. Data Analysis

<u>Orbital Data</u> (Non-realtime)

User: a. Program Engineer (SPO Office)

4. When Lt. Kirsch was asked about the present Bird Buffer utilization, he replied that only 4 percent of the time are there more than four Bird Buffers in operation at one time. He also stated that they did not use all of the Bird Buffers to support operations because they had line sync problems whenever a Bird

Buffer was switched between stations. It is for this reason that the Bird Buffers are dedicated to a particular RTS.

5. The Lockheed personnel were very interested in a multiprocessing system for use in the Bird Buffer application. They stated that there would be an initial problem with NSA data security requirements. However, once NSA was convinced of multiprocessing software data protection methods, the operation of the system could be fairly "relaxed."

6. Major Reed was very interested in the 2250's capabilities and potential for alleviating his scheduling problems. Although the 2250/160A configuration would not afford the amount of flexibility required, he stated that he would be interested in any detail presentation we might present on the 2250's without reference to CPU restriction; i.e., 2250/OS 360.

7. Attached is the data flow in the STC.

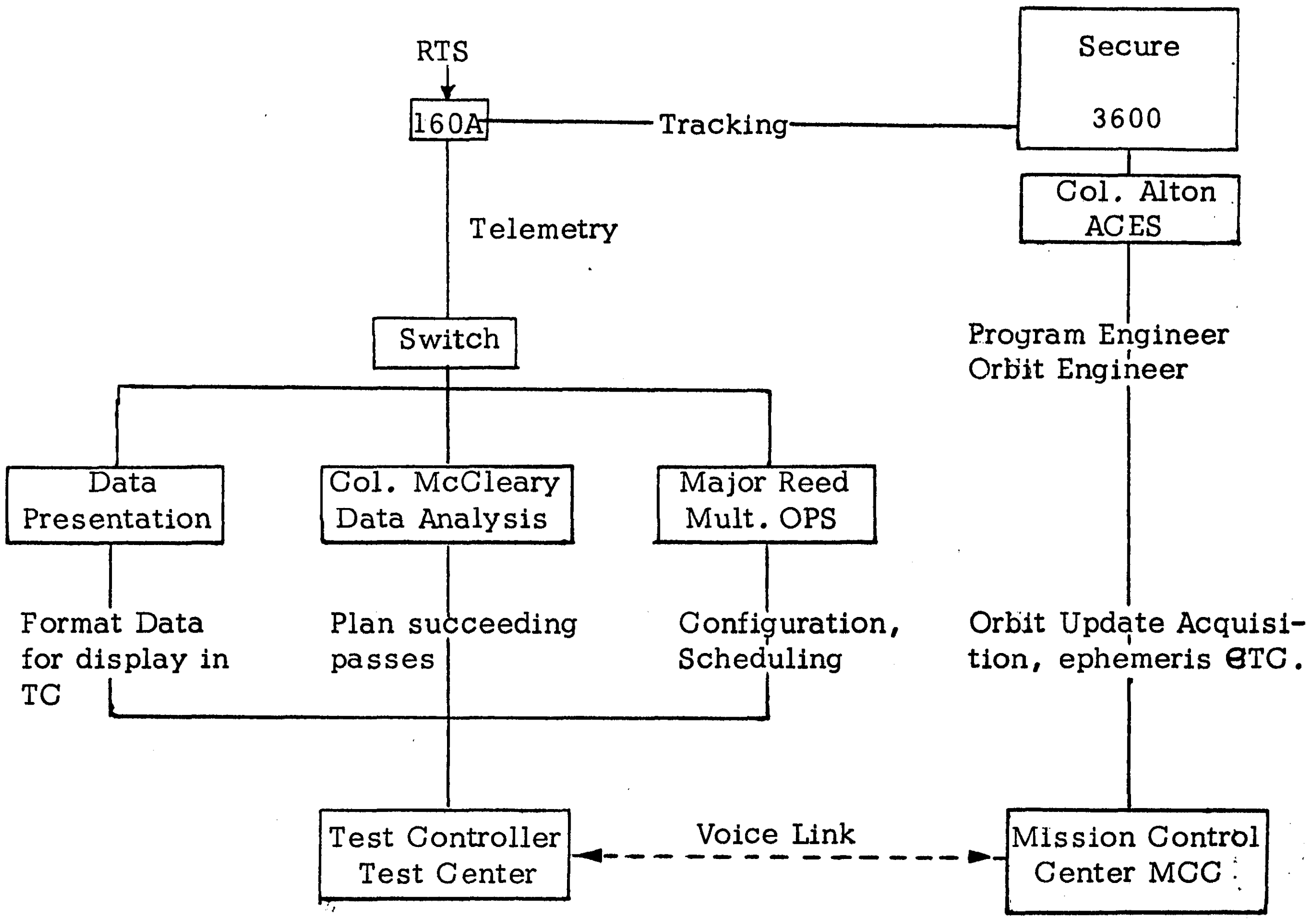
R.V. Coalson

R. V. Coalson

RVC/lr (attachment)

cc: Messrs. J. E. Hamlin, MOL
R. Mowlem, Bethesda
M. Needle, MOL

Data Flow in the Satellite Test Center



Note: The MCC will eventually contain the Program Engineer, Data Analysis team, Data Presentation Team and the Test Controller for each particular mission. The MCC's will be functionally reproduced as support dictates.

IBM CONFIDENTIAL

IBM

Date: February 10, 1966
From (Dept. Loc): MOL Project
Telephone Ext.:

Subject: CDC Price Change

Reference:

To: Mr. W. B. Gibson

CDC has just recently announced the following price changes to their 3800 system:

3804 Processor and Control		
	was $14,000 rental	$710,000 purchase
	now 11,500 "	450,000 "
3803 Core Storage (32K)		
	was $13,000 rental	$560,000 purchase
	now 9,250 "	360,000 "

The remaining component prices remain unchanged.

This lowers the 3800 system rental price to $2,250 below an equivalent 3600 system.

Substitution of 3800 processing units for the installed 3600's at the STC would result in an estimated savings of $1,750 per system. In addition, if the 3804 and 3803 are purchased for the STC, payout, excluding maintenance, is achieved in 40 months, while the system is good for at least 5 years.

The current National Comstat shows the following:

System	Account	Status
3800	OSN Fleet NUM	Firm Order
3800	Mobil Geophysical	Doubtful
3870	NRL	Firm Order
3870	NASA - Michoud	Doubtful
3870	Navy Post Graduate School	"
3870	NMCS	"

(The 3870 is the time-sharing version of the 3800)

Mort

Mort Needle

MBN/lr
cc: Mr. C. B. Brown,
Mr. R. G. Krause

Manned Orbiting Laboratory Project
LOS ANGELES AEROSPACE BUILDING

March 25, 1966

IBM CONFIDENTIAL

TO: Mr. C. B. Brown
Mr. W. B. Gibson
Mr. J. E. Hamlin
Mr. J. J. Selfridge

9020 VERTICAL GROWTH

I discussed the subject with Lloyd Cudney, 9020 engineering. A similar request has already been investigated for the NAPALM proposal, which is a 9020 system for the U. S. Army.

Conclusions were as follows:

1. Internal speed is more of a limiting factor than SE speeds.

2. Speed improvements of either CE or SE are not economically feasible, since a different circuit family would be required.

3. The development effort of substituting 2365's (.75 microsecond) with 9020 capability for SE's is estimated at $1 million.

NAPALM has been informed that there is no vertical growth capability on the 9020.

The idea of hanging a 65 or 75 on one of the SE memory tails and treating the SE as bulk core is feasible, but has not been investigated as to complexity of interfacing the two different circuit families.

Summary:

1. Our proposal should avoid committing us to a specific type of vertical growth.

2. We can commit to growth, since there are the following possibilities:

   a. Shared I/O devices
   b. Channel to Channel
   c. A more powerful CPU on one memory tail
   d. RPQ 9020 capabilities onto shared memory 65's

T. M. Charbonneau

T. M. Charbonneau

TMC/lr
cc: Mr. Lloyd Cudney, POK 9020 Eng.

April 5, 1966

MEMORANDUM TO: The File

SUBJECT: 9020 Software

Following information was gained from conversation with Ken Kowalke:

The programming developments for the 9020 consist of the following:

1. Utility systems. This consists of the utility monitor, JOVIAL compiler, basic assembly language, mathematical subroutines, loader and librarian/editor. These consist of a total of 250,000 lines of code and have all been delivered and accepted. The JOVIAL compiler is a relatively fast compiler and uses 256K bytes of core. It compares favorably with the J 2 compiler for the 7090.

2. Diagnostics consist of the SEVA system which are systems diagnostics. In addition, there are functional diagnostics for each box. Further, the storage units, computing elements and IOCE's all have fault location technology microprograms. These consist of a total 500,000 lines of code or their equivalent and are 99% written and debugged.

3. The operational programs consist of two portions:

   a. Non-operational which includes the upgrade utility monitor, simulator and specialized programs. These consist of 50,000 lines of code.

   b. The operational programs, in addition to using the above, consist of using the operational monitor which was estimated, at the time of proposal, to require 65,000 lines of code.

W. B. Gibson

WBG:jb

SDD POUGHKEEPSIE
Dept. B70 - Bldg. 951
Extension - 57538

May 25, 1966

Memorandum to: Mr. J. J. Selfridge

Subject: Alternate Bird Buffer Configuration

Reference: Meeting in Poughkeepsie, May 10, 11, 1966

In regard to the discussion concerning Md 44's as an alternate configuration for the Bird Buffer, I would like to sum up the conclusions reached at the meeting:

Assuming high availability, error checking analysis, and automatic partitioning as prerequisites for the Bird Buffer, the following reasons for not going with the Md 44 should be considered.

1. Lack of spare board room in Md 44 eliminates any expansion without going to a separate box.

2. Memory and channels are integral part of Md 44 which limits partitioning. To separate memory would be expensive for a one-of-a-kind system and would increase memory speed to at least 1.5 usec.

3. Lack of error checking in the Md 44 severely limits its application as a Bird Buffer.

Because of the above disadvantages of the Md 44, I would like to suggest two alternate configurations for your consideration.

1. Three stand-alone Md 50's, each having its own storage plus duplexed shared LCS.

2. Three Md 50's with shared storage.

Either of the above configurations are capable of meeting the presently defined Bird Buffer requirements. In fact, if future growth becomes a consideration, both of these configurations have a decided advantage over the prime candidate, the 9020.

Comments concerning acceptance or rejection of the proposed configurations would be appreciated.

D. A. Dossin

DAD/dml

cc: Mr. C. B. Brown, Los Angeles
Mr. J. F. DeRose
Mr. D. Fuchs, Los Angeles
Mr. C. R. Harden
Mr. R. B. Hurley
Mr. R. B. Talmadge, Los Angeles
Mr. J. M. Terlato
Mr. G. West, Los Angeles

Date: June 6, 1966
From (Dept-Loc.): Advanced Programs, Los Angeles, California
Phone Ext.: 427

Subject: STC Buffer Computer Configuration

Reference: Memorandum of May 25, 1966, from D. Dossin to J.J.Selfridge

To: Mr. D. Dossin, Bldg. 951, Dept. B70,Poughkeepsie

The Model 9020 is our first choice for the STC buffer computer due to its hardware features for multi-processing and reliability, and the software that could be furnished at no cost. However, our proposing the 9020 is dependent on obtaining an attractive lease price for the machine.

In the event the 9020 price is unfavorable, we feel a configuration based on the Model 44 would be more suitable than any other configuration of System/360 computers. Considerable cost savings in programming and documentation would result by having similar computers at the control center and the remote stations. Furthermore, the Model 44 offers a competitive price/performance ratio.

We have recently received information that the Model 44 is being considered as a base for a time-sharing system with many of the features we need for the STC.[1] The time-sharing configuration would offer a two-processor system with the full System/360 instruction set, dynamic address translation, seven-bit storage protection, separate memory boxes and partitioning capability. It appears that the Model 44 modifications we had requested are more practical than indicated in our meeting of 10 May.

A configuration of stand-alone Model 50s with shared LCS must be ruled out as a possible configuration, since this does not suit our application. Our design calls for all programs to be resident in main storage all the time and there is no advantage to LCS over disk for data storage. A configuration of Model 50s with shared main storage would suit our application but would not be compatible with the 9020 and 44 rationale stated above.

In light of the studies involving the 44 time-sharing system, we would like to pursue the Model 44 modifications listed at our meeting on the 10th of May which were to have been discussed with the Hursley people.

G D West

G. D. West

GDW:jh
cc: C.B.Brown, J.F.DeRose, D.Fuchs, C.R.Harden, R.B.Hurley, J.J.Selfridge, R.B.Talmadge, J.M.Terlato.

1. "Forecast assumptions: System/360, Model 44 TS"; SSD Poughkeepsie, Department D48, Building 706; 25 April, 1966.

CUSTOMER NAME:	Satellite Control Facility Computing Support Space Systems Division Inglewood, California
REGION:	GEM
DISTRICT:	Western
BRANCH:	Los Angeles Westchester
BRANCH MANAGER:	Skip Hoyt
ACCOUNT MANAGER:	Ed Chappelear
D. P. SALESMAN:	Bob Fairbanks Bob Krause Bob Oller
FSD REPRESENTATIVE:	Johnny Jones Jim Selfridge Glen McClure

PART II. 3600 COSTS (Although Several 1604's are yet in system; they are in process of being phased out and replaced; monthly rentals were approximately same).

ITEM	NO.	TOTAL
3604 Processor and Console	1	13,000
3603 Core Storage	1	10,000
3606 Data Channel (900 ea.)	5	4,500
3623 Mag. Tape Controller	1	2,900
606 Mag. Tape Transport (825 ea.)	8	6,600
3602 Com. Module	1	2,000
3644 Card Punch Controller	1	675
3649 Card Reader Controller	1	325
405 Card Reader	1	400
415 Card Punch	1	295
3659 Line Printer Controller	1	700
501 Line Printer	11	865
3691 P-T Reader Punch	1	310
3681 Data Channel Converter	1	275
3682 Satellite Coupler	1	175
3000/7000 Data Channel Adapter (Approx)	11	1,000
7631-2 File Control	1	835
1301-1 Disk File	1	2,100
731 Typewriter (approx.)	1	45

Total Single Configuration : 47,000

Configurations in SCF: 5-STC; 2-AF 376,000

TOTAL SCF MONTHLY CDC LEASE: 700,938

STC
MANAGEMENT PROGRAMS

FOREWORD

Many times in the past, programs for Computer utilization in scheduling, configuration control, and information display have been either too automatic (i.e.close to 100% computer control) and thus too complicated and costly to be practically or economically feasible, or they have been too manual and thus too time consuming and liable to human error to be desirable.

The optimum approach is computer operated programs which allow manual interaction or intervention in those areas where human capability exceed those of the computer in practical application. Specifically, decision making should be a human task while data massaging, formatting, and display is a logical computer task.

Normally, human interaction with computers causes excessive waste of computer operating time in that the computer is "tied up" and unable to process other tasks when a human interruption is enacted to allow decision making.

This is no longer true with the introduction of 2250's, with separate buffer, and multiprocessing (or multiprogramming) with executive monitors and priority, task tables. Information necessary for decision making can be displayed via the 2250 buffer while the CPU is released for other tasks. An interrupt via the 2250 keyboard then places the task back in the CPU on a priority basis after the appropriate human decisions have been made.

An improved, well delineated interaction, between the human delegated the responsibility for a task and the computer which is designed for expediting the task, is the design goal for the programs which follow.

SCHEDULING & IMPLEMENTATION PROGRAM (SIP)

The manual scheduling system now in use at the STC has two inherent problems; (1) liability to human error, and (2) extreme time consumption between workable schedules.

The scheduling and implementation program (SIP) is a computerized method of scheduling which will accomplish the following:

a. Automate the establishment of of N-hour** schedules showing stations, satellite acquisition times, and Program Office support requests.

b. Expedite the resolvement of support conflicts*.

c. Automate the issuance of final schedules to the appropriate Remote Tracking Stations and STC personnel.

d. Display esoteric information to user personnel in the STC.

e. Record specified information for history.

* Support Conflicts: ~~Define~~ two or more support requests at the same RTS for the same time period, or for two time periods too close together in time to allow turn around at the RTS.

**N = the time specified by multioperations.

The SIP will be supplied its required input from four sources: the 3600 off-line computers, multi-operations, the Program Project offices, selected data from the configuration control program (described later).

1. Multi-Operations - will manually input the RTS's by name and code representation. Once input, this information will remain in permanent storage.

2. Configuration Control Program - will supply up to date RTS support capability.

3. 3600's - will supply acquisition times of satellites over the stations (i.e. rise to set times) for an n-hour time period.

4. Project Offices - will supply statement of support requirements for each satellite over each station.

Utilizing the above inputs, SIP will generate a schedule for N-hours encompassing the entire SCF tracking network supporting all missions. Naturally, all of the support requests will be impossible to satisfy, therefore the 2250 will indicate conflicts utilizing flashing lights, arrows, etc. The 2250 operator will then call the sites one at a time and the scale will be expanded to facilitate analysis of the conflicts. (See Figure 1) After consultation with the Project Office personnel involved, the scheduler will input data to the SIP to reflect changes in the support requests and a new workable (no conflicts) schedule will be generated. After verification of the new schedule by all involved, the 2250 will be keyed and the schedule will be transmitted over teletype to the site involved. The schedule will also be stored for history and printed on hard copy for mangement information. The remaining sites will be scheduled in the same manner.

CONFIGURATION CONTROL PROGRAM (CCOP)

In order for configuration control to be as automated as possible, configuration information must be gathered and displayed through a computer operated system sensing medium. In a multiprocessing system, which is under the auspices of a control monitor, the monitor can act as the sensing medium for obtaining very general information about SCF system configuration (i.e. which sites are connected to the computing system and in which mode they are operating). However, in order for configuration control to be a truly useful tool of management, a more detailed level of configuration information must be obtained and continuously updated in "real time". The best medium for obtaining detailed information is the set of diagnostic programs which are operated to ascertain STC and RTS support capability. NOTE: At any time, voice communication with support elements of the STC system can provide up to date information on configuration. This data can be input to CCOP via 2250 keyboard.

The Configuration Control Program (CCP) will sense the results of diagnostics and tag "out of tolerance" (i.e. not capable of supporting) conditions and down grade a 100% support model to reflect non-supporting elements, and display the configuration on the 2250 dedicated to configuration control. In many instances out of tolerance conditions, as defined by diagnostics, will be overruled by project personnel and will become conditions of concern rather than conditions of non-support. Conditions of concern should not be reflected in the CCP; therefore, a manual input (via the 2250 keyboard) should be generated to reflect project personnel decisions and override the diagnostics flags. NOTE: Conditions of concern will be shown in the Management Information Program.

For Programmed configuration control, planned RTS down time can be input to the CCOP to reflect planned support configurations for any increment of time necessary for good operational control. (Example: Philco plans 1 week down time for Hula in order to accomplish scheduled maintenance. This maintenance is to commence two weeks from the present date. This date can be fed to the CCOP and a support capability can be established for the period beginning two weeks from the present date. The support capability data can then be fed to the scheduling program for the establishment of a support schedule. Any change in the planned maintenance can be quickly reflected in the schedule by the changing of a few parameters and the resolvement of any consequent support conflicts.

Another use of the CCOP would be to tabulate history data for management usage. Since the CCOP would utilize all the information which describes anomalies or catastrophic failures of the support system, a history file can be maintained to reflect chornic or repetitive problem areas. The weak areas of the support system, the necessity for altered preventative maintenance schedules, etc., can be established simply by keying a call to the tabluated history file. This same concept could be extended to cover orbiting systems as well. (Example: The repetitive rejection of commands by certain satellites could be tabulated for history)

MANAGEMENT INFORMATION PROGRAM (MIP)

Management information is simply an outline or brief of all data of critical nature which is utilized for effective management of an operational support system. Management information is usually gathered after a request has been made for information concerning a particular aspect of the system. The data requested is then manually collected from recorded date (and conversations with support personnel) to reflect the information required. MIP, then, is a program which gathers, formats and displays information necessary for effective management of the entire support system.

The following types of information are required for updating the Management Information Program:

a. Daily support schedules (obtained from SIMP)

b. Daily equipment configurations and equipment status (obtained from CCOP)

c. Voice Communication with the RTS's.

The information will be used primarily for two purposes:

I. SCF management planning for future procurements, technical direction to contractors, etc.

II. System Controller and Data Systems Controller directions during missions to assure rapid, well planned and orderly assignments for correcting abnormal conditions (anomalies, reconfigurations, equipment repairs, etc.)

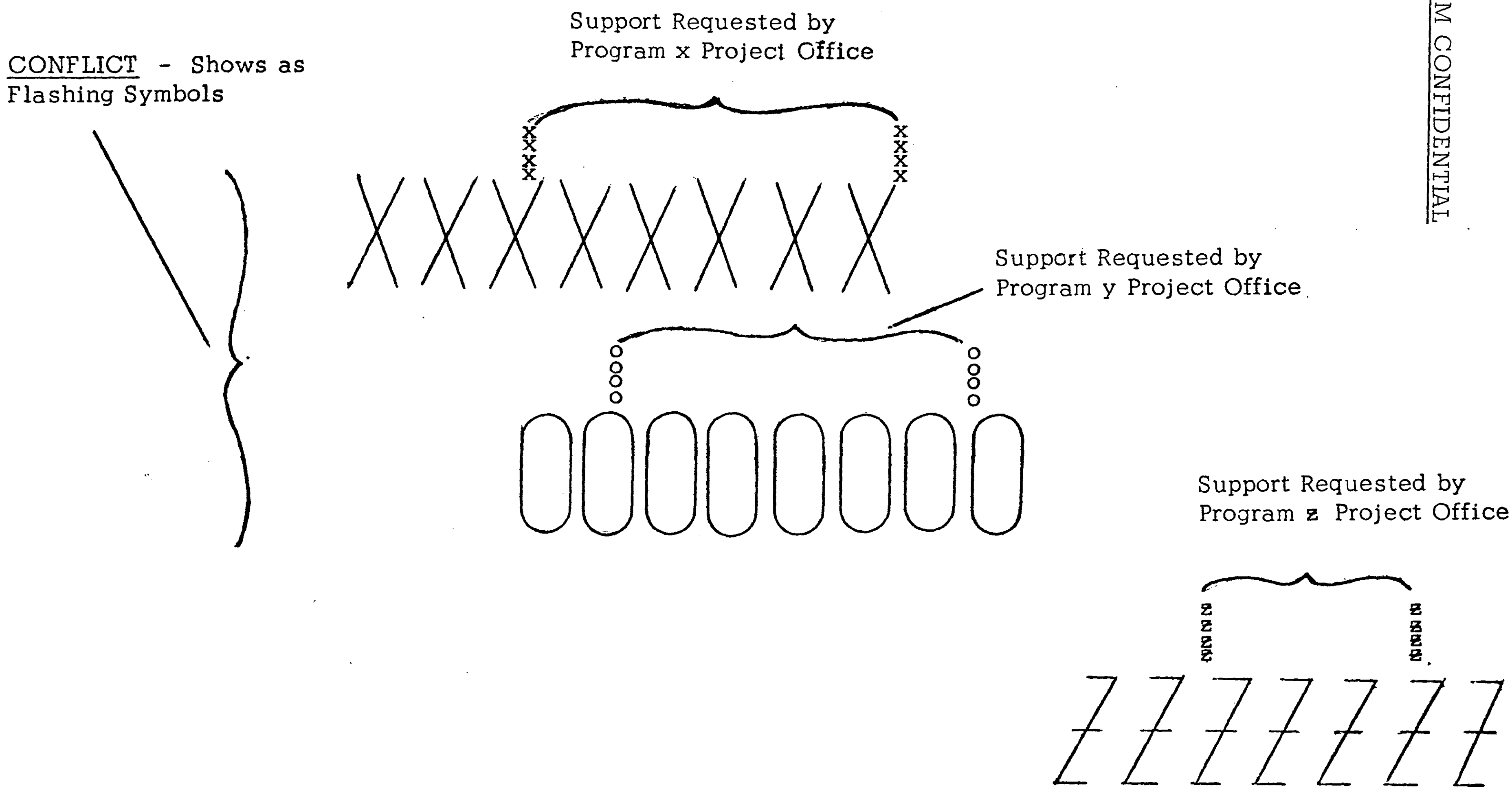
1. Since Management planning is based upon statistics of past, present and projected future operations, there is a continuous gathering of information to substantiate management positions. Technical direction to contractors requires operational data to substantiate the requirements levied upon the contractors by the Air Force management. The Management Information Program will provide the needed data in near real-time in any of various formats desired. MIP will not require extensive data processing since it will draw the needed information from existing operational programs. The MIP display medium (2250 or hard copy) will provide the capability to chose formats which best suit the time of inquiry. Most of the information will

come from the CCOP. (Note description of CCOP preceding)

2. Operationally the MIP will be very useful to the System Controller and the Data Systems Controller. When unexpected anomalies occur in the STC System (includes RTS's), the System Controller can call information sufficient to make rapid assessments of the problem area(s) and delegate the responsibility for repair. Since he will know the degree of the problem, he will be able to make accurate estimates as to time of repair and the seriousness of the difficulty. This is especially important in manned orbital missions since ground support during repair missions is of paramount importance. The ground support personnel must have enough information to properly assess the situation. The MIP will satisfy this requirement.

EXAMPLE
SINGLE SITE RESOLUTION

HULA



TIME ——→ N Hour Schedule

Could be Overlays

Codes for Satellite Programs

Example: xxxxx = program x
ooooo = program y
zzzzz = program z

CUSTOMER NAME:	National Range Division Air Force Systems Commmand Washington, D.C.
REGION:	GEM
PROGRAM:	Air Force Programs
PROGRAM DIRECTOR:	Ray Simms
PROGRAM MANAGER:	Jack Richardson
SPECIAL REPRESENTATIVE:	Bob Bruns
SYSTEMS ENGINEER:	Michael Bibault
FSD REPRESENTATIVE:	Ken Driessen

HQ NRD OFFICE SYMBOLS
PATRICK AFB

11 June 1965

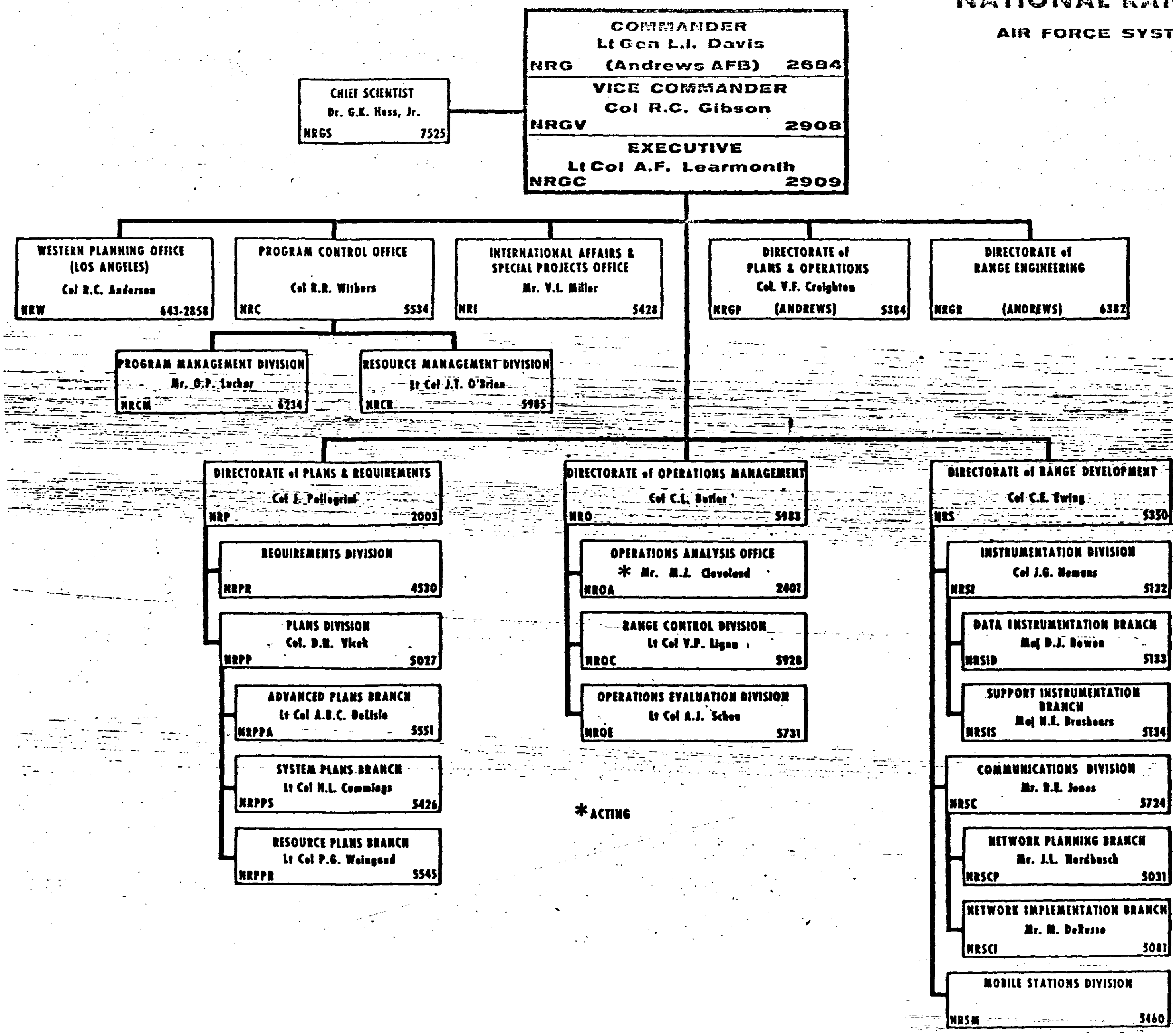
NRG	COMMANDER	Gen. Davis
NRGV	Vice Commander	Col. Gibson
NRGC	Executive	Lt. Col. Learnmonth
NRGS	Chief Scientist	Dr. Hess
	Asst. Chief Scientist	Lt. Col. Lake
NRA	OFFICE OF ADMIN SERVICES	
NRC	PROGRAM CONTROL OFFICE	
NRCM	Program Management Division	Mr. Lachar
NRCR	Resource Management Division	Lt. Col. O'Brien
NRI	INTERNATIONAL AFFAIRS AND SPECIAL PROJECTS OFFICE	
NRO	DIRECTORATE OF OPERATIONS MANAGEMENT	Col. Butler (open)
NROA	Operations Analysis Office	(open)
NROC	Range Control Division	Lt. Col. Ligon
NROE	Operations Evaluation Division	Lt. Col. Schou
NRP	DIRECTORATE OF PLANS AND REQUIREMENTS	Col. Pellegrini
NRPR	Requirements Division	Lt. Col. Lineberger Dr. Fennema
NRPP	Plans Division	Col Volcek, Perhacs
NRPPA	Advanced Plans Branch	Lt. Col. De Lisle
NRPPR	Resource Plans Branch	Lt. Col. Weingand
NRPPS	Systems Plans Branch	Lt. Col. Cummings
NRS	DIRECTORATE OF RANGE DEVELOPMENT	Col. Ewing
NRSC	Communications Division	Mr. Jones
NRSCI	Network Implementation Branch	Mr. De Russo
NRSCP	Network Planning Branch	Mr. Nordbusch
NRSI	Instrumentation Division	Col. Hemans
NRSID	Data Instrumentation Branch	Maj. Haberman
NRSIS	Support Instrumentation Branch	Maj. Brashears
NRSM	Mobile Stations Division	Lt. Col. (open)
NRSP	Air Force Representative, ISPO	
NRW	WESTERN PLANNING OFFICE (Los Angles AF Station)	Col. Anderson
NRZ	PERSONNEL	
DDMS	DOD MANNED SPACE FLIGHT SUPPORT OFFICE	
	Col. Olson	Maj. Magrane

DEPUTY COMMANDER AFSC FOR GLOBAL RANGE (Andrews AFB, Wash)

SCGR	DEPUTY COMMANDER
SCGRP	Directorate of Plans and Operations
SCGRS	Directorate of Range Development

Prepared by the Office of Administrative Services, Patrick AFB, Florida

HEADQUARTERS
NATIONAL RANGE DIVISION
AIR FORCE SYSTEMS COMMAND



Prepared by:
RESOURCE MANAGEMENT DIVISION
1 OCTOBER 1965

FACT SHEET

OFFICE OF INFORMATION
NATIONAL RANGE DIVISION, DET. 1
PATRICK AIR FORCE BASE, FLORIDA
TELEPHONE COCOA BEACH, FLA. 494-7733

BIOGRAPHY

of

LIEUTENANT GENERAL LEIGHTON (LEE) IRA DAVIS

General Davis commands the National Range Division(NRD) and is Department of Defense Manager for Manned Space Flight Support Operations.

Born in Sparta, Wisconsin, February 20, 1910.

Entered United States Military Academy in 1931, graduated 1935. Also holds Masters Degree in Aeronautical Engineering from Massachusetts Institute of Technology (1941) and is a graduate of Air War College (1950).

Received pilot rating 1936, now holds Command Pilot rating.

Assignments bear out reputation as soldier-scientist. Instructor, Department of Mechanics, West Point (1939-1942); Ground School Director, West Point (1942-43); Project Officer Technical Executive, Chief, Armament Laboratory (1943-47); Assistant Chief, Engineering Plans Branch, Engineering Division (1947-48), Chief, Applied Research Section, Air Materiel Command (1948-49), Chief, OFC Air Research, AMC (1949) - All at Wright-Patterson AFB (1950-51); Deputy Commander and Commander, USAFIT, Wright-Patterson AFB (1950-51); Director of Armament, ARDC (1951-52); Assistant Director and Director of Development, ARDC, (1952-54); Commander, Air Force Missile Development Center, Holloman AFB, N. M. (1954-58); Deputy Commander for Research and Development, ARDC (1958-59); Assistant Deputy Chief of Staff, Development, Headquarters USAF (1959); Commander, AFMTC, Patrick AFB, Florida (May 1960).

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General Davis is married to the former Gertrude Austin of Lyndhurst, N. J. Three children, Mrs. Robert M. Brown, Mrs. James C. Faris, and son, Leighton I. Davis, Jr.

Received Legion of Merit for development of electronic pressure-time, pressure volume equipment used at West Point, Oak Leaf Cluster of Legion of Merit for design and development of gun-bomb-rocket sights for fighter aircraft. Received Thurman H. Bane Award from Institute of Aeronautical Sciences for work in developing fire control equipment and Honorary LLB, from the New Mexico State University. On May 21, 1963, the late President Kennedy presented General Davis with the National Aeronautics and Space Administration's Medal for Outstanding Leadership in recognition of his contribution to Project Mercury.

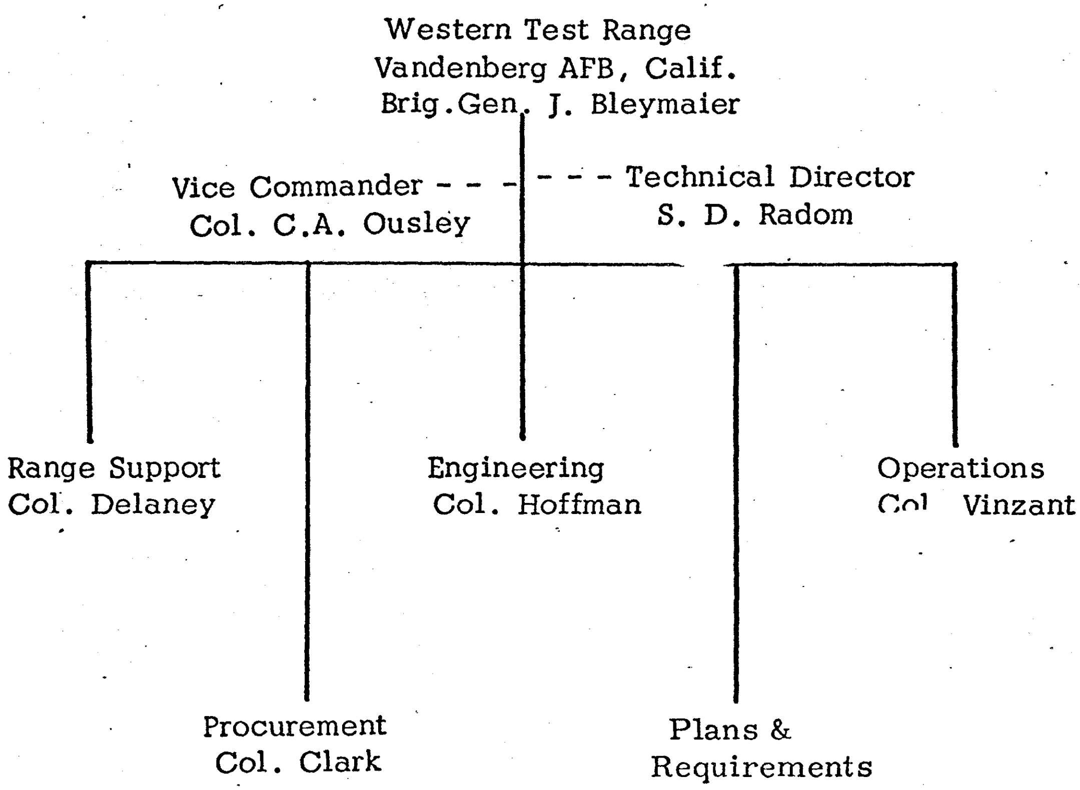
For recreation likes golf (shoots in low eighties), bridge, enjoys hi-fi, fond of hunting and fishing. Has extensive collection of electronic devices which he constructed, and war game which he patented.

Is Fellow of American Rocket Society, member of Order of Daedalians.

General Davis assumed command of the National Range Division on 2 January 1964, and was promoted to Lieutenant General on 1 June 1964.

-AFETR-

CUSTOMER NAME:	Western Test Range, Vandenberg Air Force Base, California.
REGION:	GEM
DISTRICT:	Western
BRANCH:	Los Angeles, Westchester.
BRANCH MANAGER:	Skip Hoyt
ACCOUNT MANAGER:	Paul DePascal
DP SALESMAN:	Jay Priday
SYSTEMS ENGINEER:	Dick Stanley
FSD REPRESENTATIVE:	Paul Lindfors, Johnny Jones, Jim Hamlin.


Western Test Range
Vandenberg AFB, Calif.
Brig.Gen. J. Bleymaier
Vice Commander
Col. C.A. Ousley
Technical Director
S. D. Radom
Range Support
Col. Delaney
Procurement
Col. Clark
Engineering
Col. Hoffman
Plans &
Requirements
Operations
Col. Vinzant

Range Support
Col. Delaney

Air Force	IBM
Lt.Col. R.F. O'Neil - Personnel	Paul O. Lindfors
Lt.Col. L.W. Fry - Materiel	John Jones
Lt.Col. H.L. Stillens - Comptroller	Jay Priday
Maj. L. R. Gill - Administration	Dick Stanley
	Paul DePascale

Engineering
Col. Hoffman - - - - - Technical Advisor
Bill McGraw

Air Force

Lt.Col. J. M. Ellzey - Ships
Lt.Col. P. Andrae - Proj. Control
(1) Mr. W. Cuthbert - Instr. Engr.
(1) Mr. B. Ames - Comm. Engr.
(1) Mr. C. Cusworth - Comp. Engr.
Col. C. H. Andrews - Facilities Engr.
(2) Mr. Bob Effenberger
(3) Mr. Jim Allison
(2) Mr. Chuck LeRoy
(3) Mr. Ted Barr
Maj. Glen Ballantyne - MOL Range Support- Special Assignment
Mr. Lou Kraff - Director Systems Engineering
Mr. Bert Larey - Systems Engineer
Mr. Chesebro - Communications Engineer
(2) Mr. Criddle
(4) Mr. Binglle - Command & Control

IBM

Paul O. Lindfors
John Jones
Jay Priday
Dick Stanley
Paul DePascale

(number) - Denotes chain of Command under particular section

Operations
Col. Vinzant

Air Force

(1) Mr. Alexander - Range Data
LT. Col. Montalvo - Range Ops.
Lt.Col. R.B. Moody - Range Safety
Col. Hill - Chief Scientist for Range Operations
(2) Mr. McDowell) Math. Analysis Ap.
(3) Mr. Cristophono)

IBM

Paul O. Lindfors
John Jones
Jay Priday
Dick Stanley
Paul DePascale

Procurement
Col. Clark

Air Force

Lt.Col. R. F. O'Neil
Mr. W. T. Heavner
Mr. K. Ito
Mr. D. Templeman

IBM

Paul O. Lindfors
John Jones
Jay Priday
Dick Stanley
Paul DePascale

Plans and Requirements - - - - Colonel Godfrey

Air Force

Col. Carey - Advanced Plans
Mr. Bradford
Lt. Colonel Chuck Fellows - Director, Advanced Programs

Technical Director to Commander - - - - Mr. S. D. Radom

<u>Air Force</u>
Mr. Gene Clarey - Chief of Operations Analysis

C. CURRENT STATUS

C.1 A Technical Report entitled "Consolidated Range Control Center" was completed and delivered to WTR December 15. The introduction to the report follows. Further information concerning this report can be obtained through the MOL Project Office.

1.0 INTRODUCTION

1.1 SCOPE OF THE REPORT

The present growth potential of the Air Force Western Test Range dictates the consideration of a Consolidated Range Control Center to meet AFWTR functional requirements and allow for modular expansion of both the hardware and programming systems. This technical report presents the IBM preliminary system design for the CRCC at AFWTR.

The contents of the report are ordered to allow both quick assessment of the composite system and detailed perusal of its individual elements. An abstract of its subject sequence follows:

Section 1 Design Considerations

A summary of considerations which influenced the design of the system.

Section 2 General System Design

A condensed identification and description of the computing system which IBM has designed for CRCC. Includes graphic summaries of hardware and software subsystems and range functions which the system supports.

Section 3 Detailed System Descriptions

Detailed technical discussion of the CRCC computer configuration, the telemetry receiving complex, the communication system, computer application and system programming, the management information system, and the range safety function is discussed.

Section 4 Facilities

Description of facility considerations which result from design of the data system.

This data system design for the CRCC has been based upon IBM's present understanding of AFWTR functional requirements. To this extent, the system should be regarded as preliminary since numerous contingencies can modify support requirements as the range grows.

IBM will welcome the range's response to this design approach and is prepared to modify and adapt as the system contingencies arise in AFWTR's expanding user support mission.

1.2 DESIGN CONSIDERATIONS

In considering the various aspects of a consolidated approach, it becomes apparent that the computing function provides the single element common to most system users. It is, however, quite clear that the computing elements of this system cannot be specified in an abstract fashion. It is convenient to consider the computing system as a node point in the flow of raw and processed data at AFWTR. The design of the data processing system must reflect a capability to accommodate the network of data flow paths as envisioned during and after the consolidation. The key factors to consider are the number of data paths arriving at or emanating from the computing complex and the maximum expected over-all data flow rate.

Closely allied with the requirement to receive and transmit data is the amount and type of processing (arithmetic, converting, routing, etc.) required to be done on this transient data in real time. These real time requirements are dictated by range operational functions such as the prediction of impact, orbit determination, quick look experiment analysis, and other rapid turn-around tasks. The need to perform a variety of real time processing while at the same time managing the flow of data will determine the characteristics of the central processing element and govern the selection of I/O devices associated with the central processor.

Once a given central processing element has been defined it is necessary to address the total processing system for the sake of achieving a configuration which will provide for maximum sustained support to on-line operations should a failure situation occur. This historically has been solved through the application of redundant elements in the system. The determining factor in establishing maximum protection against interrupt or cancelled support is the amount of time allowed to transfer critical functions from a marginal device to one that is functioning correctly. By employing appropriate switching equipment and pooling equipment, the required recovery capability can be achieved without resorting to 100% hardware duplication.

In designing a consolidated center it is also necessary to inspect the off-line or non-real time demands on the processing system. In this case, the two factors of the operating system and the I/O configuration are the determining ones. This is based on the assumption that the central processing element has been sized to accommodate the real time or mission support requirements.

The foregoing considerations can be divided into two broad categories:

1. Those pertinent to on-line real time mission support

2. Those relating to off-line operations.

Ideally, then, an equipment system should be developed which can simply and rapidly be reconfigured to meet specific applications.

In the remainder of this report, an attempt has been made to interrelate these considerations. To achieve this, the report explores the following areas:

1. Communications Network - including data rates and routes.
2. Telemetry Processing
3. Software System
4. System Applications
5. Facilities

C.2 The current status of the range plans and work loads are summed up in the reproduced MISSILES AND ROCKETS article attached.

Vandenberg Begins Expanding for MOL

Acquisition of huge ranch adjoining space base will be first step toward meeting needs of continuous launching; new Titans planned

by Robert Lindsey

VANDENBERG AIR FORCE BASE, CALIF.—The U.S. Army Corps of Engineers has been negotiating to acquire the 14,891-acre Sudden Ranch properties adjacent to this base as the first step in a massive expansion program triggered by the *Manned Orbiting Laboratory (MOL)* program.

Brig. Gen. Joseph S. Bleymaier, commander of the Western Test Range, told MISSILES AND ROCKETS he sees "a real good possibility" that within five years Vandenberg will have "continuous manned operations," involving perhaps as many as 40 or more launches a year.

Meanwhile, M/R learned that last summer's *Titan III-X* studies have matured into firm designs for two new Air Force launch vehicles that will be used to orbit advanced unmanned reconnaissance satellites and other military payloads from Vandenberg. They include:

—*Titan III-B*. This will consist of the first two stages of the *Titan III-A*, less the malfunction detection system and other man-rating equipment, plus an upper stage. Initially at least, it will be used only with an *Agena* upper stage. The *Titan III-B* will be radio-guided and be capable of orbiting payloads of about 8,000 lbs.

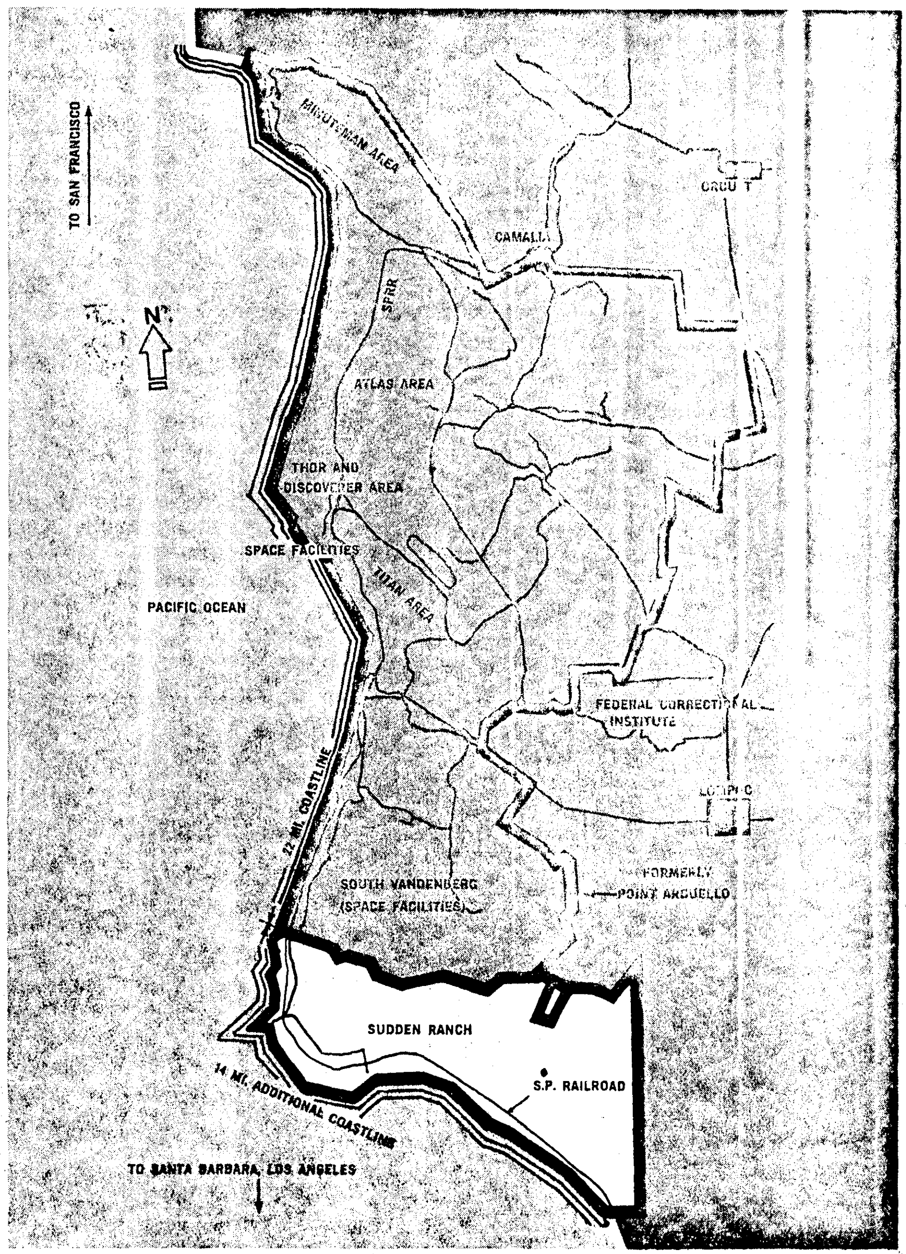
—*Titan III-D*. This will consist of the *Titan III-B*, *Agena* or other upper stage, plus two two-segment, 120-in.-dia. solid motor strap-ons. Payload will be about 50% greater than that of the *Titan III-B*, or approximately 12,000 lbs. A three-segment strap-on motor design is still under consideration.

In still another version of the *Titan III*, use of seven-segment 120-in. motors (instead of the five-segment motors used in *Titan III-C*) apparently has been firmed up for the *MOL* launches from Vandenberg. For a time at least, Air Force sources said, 156-in. motors have been ruled out of the *MOL* program.

United Technology Center of Sunnyvale, Calif., is now working on a Program Definition Phase (PDP) contract for the seven-segment motor. Informed sources say the firm will get a development contract early this year.

The seven-segment motor probably would produce about 1.5 million lbs. of thrust, compared with 1.2 million lbs. of the *Titan III-C* motor. Designation of the *Titan III* employing seven-segment motors hasn't been determined as yet, although one source said it would be dubbed *Titan III-E*.

Unmanned activity—While this Strategic Air Command base is being readied for what promises to be a fast-paced program of manned space oper-



Map shows how purchase of 14,891-acre Sudden Ranch (light area) south of existing space facilities will add substantially to both ground area and coastline.

ations, the tempo is also rising in the unmanned military space activities.

Modification of a former *Atlas-Agena* launch complex to handle the *Titan III-B* is now well under way and is scheduled to be completed late this year (M/R, Dec. 20, p. 9).

Although payloads assigned to the *Titan III-B* are classified, it is believed that the primary one is a larger version of the *SAMOS* reconnaissance satellite. *SAMOS* is now launched by an *Atlas-Agena* with a payload capability of about 7,000 lbs. Apart from its payload increase, *Titan III-B* would give this program the flexibility and quick response possible with storable propellants, not available with the *Atlas-Agena*. Larger payloads resulting from use of *III-B* and *III-D* would permit several reconnaissance refinements, including multiple film recovery capsules.

Early *MOL* qualification flights will be conducted from Cape Kennedy, but all manned *MOL* missions will be flown out of Vandenberg, to take advantage of the facility's capability to launch payloads into polar orbits.

$53 million in construction—Bleymaier estimates construction of the initial launch capability (ILC) complex for the *MOL* will take about 30 months. Hence, the launch complex should be ready for the first manned *MOL* flight in late 1968. Bleymaier said he expects work on the Sudden Ranch to hit full swing in about March. Estimated cost of ILC, an "all-purpose" facility that will also handle *Titan III-D*, is $28 million.

The single launch pad of the ILC will, in effect, be the core of the *Titan III* Integrate-Transfer-Launch (ITL) complex at Cape Kennedy. Ultimately, Bleymaier said, construction of an entire ITL here is inevitable. But he said the decision probably won't be made for "another couple of years." This points to the ITL becoming operational in about 1969 or 1970. Estimated cost of completing the ITL is about $25 million, in addition to the ILC costs, Bleymaier said.

Although there has been support for establishing the *MOL* mission control center at Vandenberg or at the Air Force Space Systems Division headquarters at El Segundo, Calif., sources said there have been no changes in early plans to give the mission to the Air Force Satellite Test Center at Sunnyvale (M/R, Nov. 22, p. 16).

"Time of Transition"—Bleymaier, the main driving force behind the highly successful *Titan III* program and a leader in early *MOL* planning, conceded that he's now seeing space operations from a new light.

"For years," he said with a grin, "I was able to lay down requirements on the ranges. Now I'm finding that having to satisfy the requirements laid down by others can be a real challenge."

This is a "time of transition" for the Western Test Range, he observed. Until now, he said, space operations here have been conducted from converted ballistic missile launch pads.

"Now for the first time we are building facilities for space from the ground up," giving the Air Force opportunities to optimize facilities to fit its needs more precisely.

Bleymaier said the WTR will require only "moderate" augmentation to handle manned flights, essentially addition of biomedical monitoring facilities along the range.

He noted that extensive space medicine facilities are being included in a new 125-bed base hospital now under construction—another sign that Vandenberg is going into the manned spaceflight business. ◘

AF Orders New 'Long Tank Thors'

LONG TANK THOR, a new version of the Douglas *Thor* space booster offering greater payload capability, will be used for the first time this summer, the Air Force has announced.

Approximately 70 ft. long, compared with 56 ft. for previous models, the new vehicle is essentially a *Thrust-Augmented Thor (TAT)* with a longer tank and upgraded solid-propellant strap-ons. The three strap-ons are off-the-shelf Castor II solid motors which add a total of 18,000 lbs. of thrust more than the Castor I motors used on the *TAT*. Thrust of a single Castor II is 70,450 lbs., compared with 64,530 for Castor I.

Air Force Space Systems Division has ordered 22 of the new vehicles from Douglas Missile and Space Systems Div., Santa Monica, Calif., at an estimated cost of $18 million. These are all production models, not modified older versions, and the Air Force expects to utilize them quickly and order further production. In the usual process of standardization, it says, the new *Thor* eventually would replace all older versions for Air Force and NASA missions.

Thrust of the main engine remains at 170,000 lbs. Total thrust of the *Long Tank Thor* is 348,000 lbs. Increased payload capability is achieved with longer burn time.

PROGRAM AND OPERATION CONTRACT

Federal Electric, who currently has this contract, has indicated that this will be up for RFP again on or about February 15, 1966. This covers both the programming and operation of the WTR Range Safety and Data Reduction Facilities.

November 15, 1965

MEMO TO THE FILE

SUBJECT: November 12 Call on Col. Carey

On November 12, Jay Priday, Dick Stanley and Bill Gibson called on Col. Carey to follow up on our Wednesday presentation. Purpose of the call was to confirm that we plan to be on the base Monday and for the following month, with a target of producing a solid and detailed design for Col. Carey within one month's time. He confirmed that this would be timely and talked for almost an hour covering the following subjects:

1. The new Headquarters area will be at Thirteenth and California right adjacent to the new building the Wing is putting up. He stated that Headquarters is moving in right next to the Wing deliberately.

2. The Wing which is proposing the TMCC, avoided talking to Headquarters until very late. When they started talking, Headquarters enthusiastically joined and endorsed their efforts. The TMCC had a computer size for real time to "shred out and display" data for the Wing. However, it had no idea of encompassing all the other WTR functions. Col. Carey states that "We propose to go all the way." We will take their computer room and gain control of their operation.

3. He stated we will reorient a communications net to come into these two new buildings.

4. We will expand the Wing activity until it's big enough to serve our needs, and we will run the Wing down in the process.

5. There will be an organizational restructuring of the Air Force Systems Command on Vandenberg soon.

6. A Division commanders meeting will be held at Vandenberg within two weeks with Shriever, Funk, General Light and Davis, the other Davis and Houston attending. The main purpose of this meeting will be a discussion of the Air Force Systems Command effort and the feeling that Shriever will reorient WTR to obtain more harmonious working relationships.

- more -

7. Therefore, Col. Carey says the Consolidated Range Control Center makes even more sense.

8. Col. Carey stated the following rules for a new center:

   a. It cannot be a "pods" operation like ETR which IBM did on RCA equipment.

   b. The executive director program must use standard Air Force supply programs such as "AFUND," "RAIS."

   c. In regard to RAIS, Col. Carey stated that he felt the Air Force Information Retrieval system developed for SAC was a better program.

   d. The system developed must have multiple accesses of data with the remote terminals in and out.

   e. The Range Safety system must have appropriate safeguards.

   f. Range safety should be split into two inputs with real-time data which can be destroyed going into the data reduction function and other data generating an audit trail for Range safety. Range safety items must be locked under the control of the Range Safety Officer.

9. Col. Carey stated that everything would be coming in via microwave if not on standard communication facilities. Jay Priday brought up the point that the CTCS seems to duplicate some of the equipment in the TMCC. Col. Carey stated that this was because he was unable to get complete control of it and that the CTCS has equipment which is common to all users. That the Range is responsible for supplying the equipment, but the user is responsible for what the data says.

10. The Wing in planning for the TMCC duplicated some of the CTCS equipment.

11. Our proposed CRCC must handle CTCS function.

12. A key target date is the 15th of December when a draft of the Range package plan must be done and ready for headquarters review. The final plan must be ready by January 15. Therefore, Col. Carey stated that our target of having a report in within a month is timely. In reference to previous discussion, the 15th of November formally was supposed to be the date at which the first draft of their Range Package Plan was prepared.

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13. We discussed with Col. Carey that we saw the main action required on our part to be in the data reduction, range safety, telemetry, management information system and communications control. He agreed that these covered the major areas. He stated that any attempt to do program control switching of communications equipment would give the communications people a fit, but told us to go ahead and try. He suggested that we use Major Conelly on his staff as assistance in entering the management information area and also if we ran into difficulty in the telemetry area.

14. We discussed the possible difficulty of securing information in the telemetry area and he said if it got too serious to see him and he would attempt to assist us. In discussing how we found out what the Range future requirements would be, he stated the following:

    a. In the immediate future STLS would be the highest performance equipment we would have to consider.

    b. They were planning on using their own military instrumentation satellite to handle communications up from the Range and, therefore, any system planned must plan on higher speed communication in the future.

15. In concluding and as we were leaving, Col. Carey stated "there is a great deal to be done. NRD Headquarters is not sensitive and doesn't recognize the problem. I need help there."

I would conclude that this is a very successful call and that we absolutely must have our systems design in two to three or four days prior to January 15 at the latest. Revisions to our plan are possible after this date but it will make it harder to be included in the Range Package Plan.

Please call me on any points of discussion or interest regarding the above.

W. B. Gibson

WBG:jb

distribution: J. E. Hamlin
C. B. Brown
J. Priday
D. Stanley
P. DePascale
R. P. Bruns
H. G. Hoyt

October 18, 1965

To: Mr. J. E. Hamlin

Subject: Trip Report - Telemetry Processing Center at WTR

On Oct. 13th I visited the Western Test Range at Vandenberg AFB. The following observations were made during various meetings held on this date.

1. Instrumentation Section of Range Engineering

   a. Mr. Jim Allison intends to submit a work statement to Procurement for a Telemetry Processing Center. He is apparently writing this work statement without input from the Computer Systems or Operations branches of his parent organization (see attachment). It is planned that this work statement will be in Procurement by Nov. 15th, with an operational system date in early 1967.

   b. Mr. Allison indicated that he is looking at two approaches in writing the system specifications and configuration. (From later conversations with Mr. Fred Barr of Computer Systems, it seems that Beckman presents one of these approaches and is probably the influencing contractor.)

   c. Mr. Allison indicated that he is interested in the long range approach, i.e., an integrated control facility, but he is not particularly biased toward an integrated facility in terms of equipment location in one centralized building.

   d. The building to house this proposed center has been approved for construction. It will consist of a 9,000 sq. ft. annex to the existing CTCS building and will cost approximately $500K.

2. Data Section of Range Operations

   a. Mr. Jim Alexander repudiated the engineering plans for a Telemetry Center. He stated that he was not intimately familiar with the work statement and further stated that he "didn't really care" (sic) since he had not submitted requirements for additional or new systems to Engineering. Mr. Alexander stated that Jim Allison's unilateral action violates the normal mode of range operations, i.e., engineering design based upon requirements levied by Operations.

3. Systems Section of Range Engineering

a. Mr. Ted Barr stated that his organization had not furnished inputs to the Telemetry Center work statement. He believes that this work statement will be proscribed by management on the grounds that there is no input from his organization.

From the above described meetings it seems apparent that Mr. Allison's plans for a Nov. 15th procurement will be vitiated due to lack of technical approval at higher levels (probably Mr. Stan Radom). The work statement will undoubtedly be rewritten with all appropriate organizations contributing inputs.

Rather than try to conform to Mr. Allison's present concept of the Telemetry Center, IBM should concentrate on the organizations most likely to influence the final procurement. Conversations with Mr. Barr and Mr. Alexander indicate are not inexorable in their ideas about an integrated facility to satisfy telemetry processing requirements. In fact, Mr. Barr seemed well pleased with the IBM approach as presented very briefly by Jay Priday and myself.

R.V. Coalson

R. V. Coalson

RVC/jeb
Attachment

Attachment to Mr. R. V. Coalson's Trip Report of October 18, 1965 to Mr. J. E. Hamlin

The persons referred to in this memo are shown organizationally below.

- WTR
  Gen. Bleymaier
  - Stan Radom - Tech. Dir.
    - Engineering
      Col. Hoffman
      - Instrumentation
        Cuthbert
        - Jim Allison
      - Systems
        Cusworth
        - Chuck LeRoy) Computer
          Ted Barr)
    - Operations
      Col. Vinzant
      - Data
        Jim Alexander

November 11, 1965

RESUME' OF BRIEFING GIVEN GENERAL BLEYMAIER AND WTR STAFF
November 10, 1965 at 2:00 p. m.

Summary:

Customer expressed disappointment that we did not present a detailed design idea. He felt our presentation was too filled with generalities and motherhood. Specifically, our recommendation of a short study prior to going out to RFP was unacceptable. This was interpreted as meaning that the customer wants immediate help from IBM in generating a design that they can use as a basis for an RFP in the near future. Attached are debriefing comments from the individuals who attended from IBM.

Action:

Since the Range is on vacation November 11, we will return Friday, the 12th, to start immediate action aimed at coming up with a detailed systems design within three weeks.

Distribution: C. B. Brown - MOL Project
R. P. Bruns - MOL Project, FRO (GEM)
J. Chapman - FSD, White Sands
P. A. DePascale - LA Federal
W. B. Gibson - MOL Project
J. E. Hamlin - FSD MOL Project
H. G. Hoyt - LA Federal
J. Jones - FSD, LA Aerospace Bldg.
P. O. Lindfors - FSD, LA Aerospace Bldg.
M. Martin - FSD, White Sands
C. E. McKittrick, Jr. - FRO (GEM)
J. H. Priday - LA Federal
J. J. Selfridge - FSD MOL Project
R. Stanley - LA Federal
R. Ursin-Smith - FSD, LA Aerospace Bldg.

DEBRIEFINGS

In Air Force fashion, each IBM attendee was asked to jot down his recollection of comments made by personnel during the meeting. These are as follows:

W. B. Gibson

Col. Montalvo: Come see operations.
I am integrated now.
Same pitch as you made 18 mo. ago only using flip charts instead of slides.

Col. Carey: We agree in concept.
We want your detailed design.
(to J. Jones) Your date is way too optimistic. We need a system in February, 1967, not October 1967.
(to J. Hamlin) Our biggest computing problem is a five station real-time fix for radar tracking.

Col. Hill: We have a good operation now. It is proceeding on schedule.

(Col. Hill is not yet completely identified as to what organization he represents)

Mr. Kraff: What information do you need from us to make a design?

Col. Carey: I want a real-time data bank with multiple access to it from users all over the range.

I understand why the computer operation should be closed but the data must be open.

I could care less whether there is one or multiple systems required to do the job.

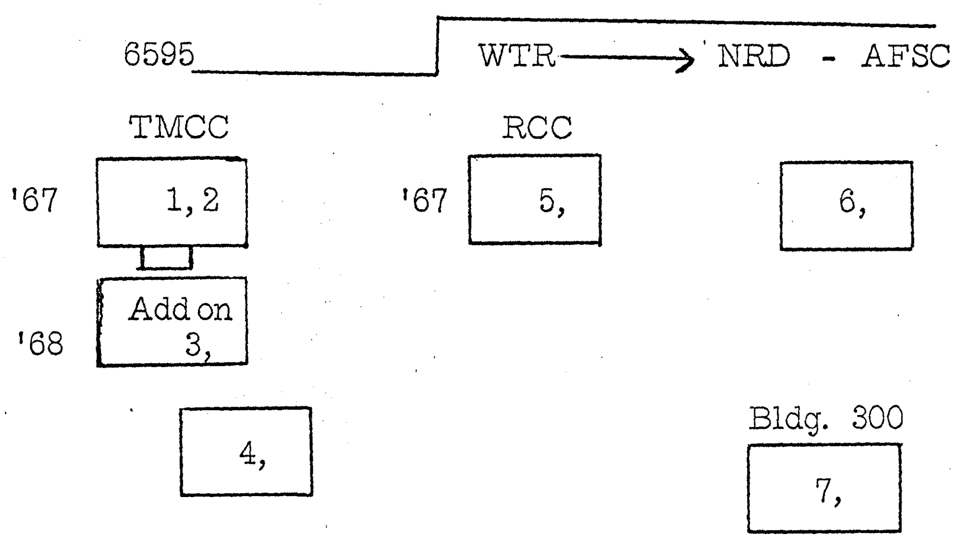
What I am interested in is square footage, people and dollars required. What are you going to do about our Range Automated Information System? We want details and specific recommendations from IBM.

J. E. Hamlin

Maj. Corley: Interested in management remote inquiry devices and methods vs. logistical and schedule information.

Mr. Don Hass: Asked mundane, courtesy question. Can't recall content nor answer.

Mr. Kraff: Agitated as hell. Really wanted IBM to come in with specific design. Wanted following dilemma identified to General



Basic conflict between centralized facility incorporating computers 1, 2, and 3 vs. second facility(ies) incorporating computers 4, 5, 6, and 7. Many of these buildings and computers are <u>already</u> in the approved plan.

He talked of the problem in use of Facilities for Headquarters purposes. He emphasized need for evolutionary growth within presently planned budget. Pleaded for correcting seemingly duplications. Will collaborate with IBM. Wants to know how to get to General again. He suggested series of design cooperative efforts.

Pointed out preface statement of recent IRI6 report on computers.

He had hoped that case would be made for continuity of effort from fabrication to checkout to mission.

J. Jones

Gen. Bleymaier:
1. He's learning - there are problems.
2. WTR is going the consolidated approach.
3. There's still some work to do.
4. Like to talk to us some more.
5. Accepted what we had to say, liked it.

Col. Carey: Apologized to Jim. Wasn't trying to shoot down the pitch. Just wanted to tell us we were way ahead last year. They are just catching up. Have to have design to get approval. Doesn't care where computers are as long as they are together and you have communication. No dedicated computers. Five stations for probably biggest job, FORTRAN IV official language NRD. Wants to put Air Force management system on a file. Wants management information system. Wants remote terminals for management information system. Wants us to come see him.

Col. Hill: Has lots of ideas and requirements. Doesn't know how he will get to answer WTR and 659th planned facilities to go together. CTC a sore spot that has to have continual money. Can't chop it out. Doesn't see why you can't furnish 72-hour tapes at the same time you plot range safety present position.

J. H. Priday

Col. Carey: Management Information System.
February, 1967.
No study.

Col. Montalvo: I have a consolidated computer.
What do I do to this facility?
He hasn't seen anything new.

Col. Hill: Doesn't want consolidated.
Havent defined existing operational problems and future requirements.

Mr. Kraff: Wants us to tell him what information we need.

J. J. Selfridge

Mr. Radom: (In his office afterward)
"You got to the general. We have some operations people problems and I'll take care of them." I told him what Bleymaier told Jones (i.e., we were on the right track). Then we were joined by

Lt. Col. Montalvo: Montalvo said, "You guys should have given us a design to pick apart. What you said today you said 18 mo. ago. We've got a system now. We want you to tell us your ideas."

Mr. Radom: "You were pitching preliminary design and it couldn't have been done without Wing and Range ties."

They both indicated that the 659th was not formally a part of AFWTR.

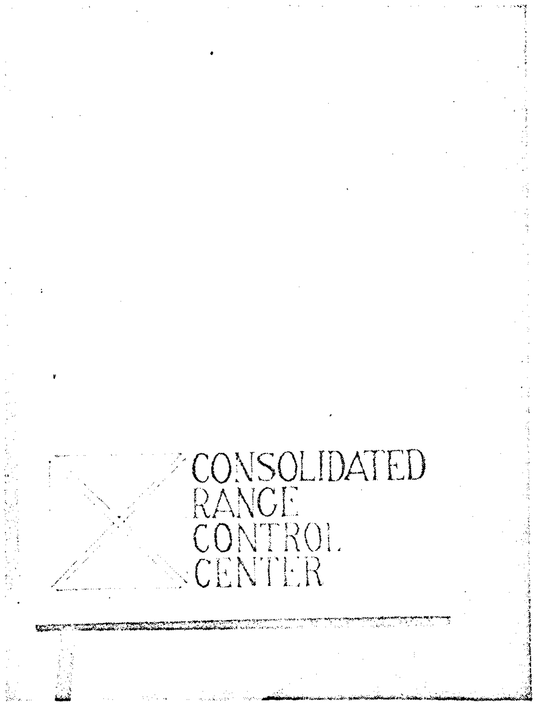
Montalvo left.

Mr. Radom: "We've got some operations types looking down a hole with blinders on." I told him that we could very easily have pitched equipment but decided against it. He said, "You made the right decision. If you had pitched IBM numbers, you would have gotten ten times worse treatment. We needed concept of starting from scratch. We can work with you now. I'll call Gibson on Friday."

###

IBM Confidential

1



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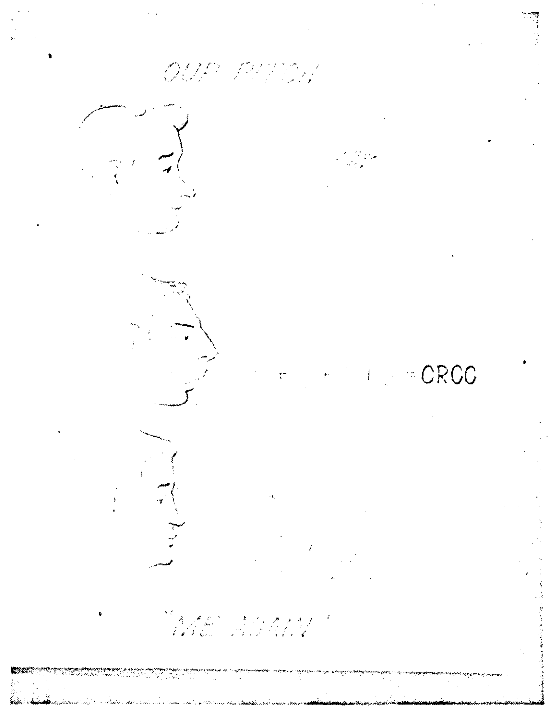

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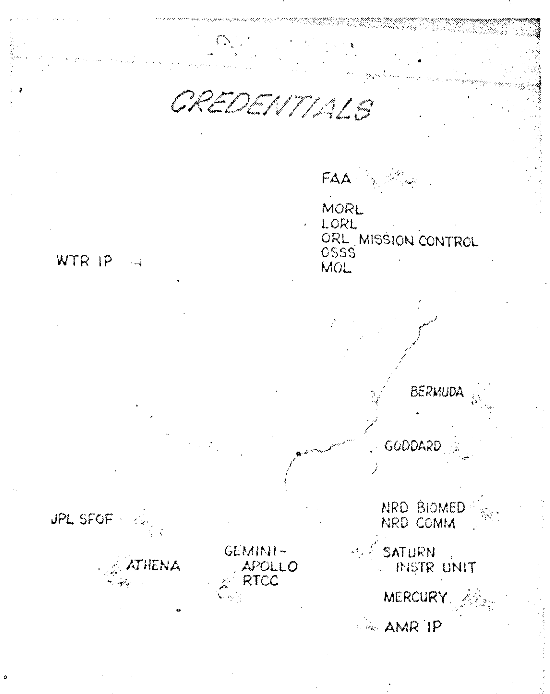

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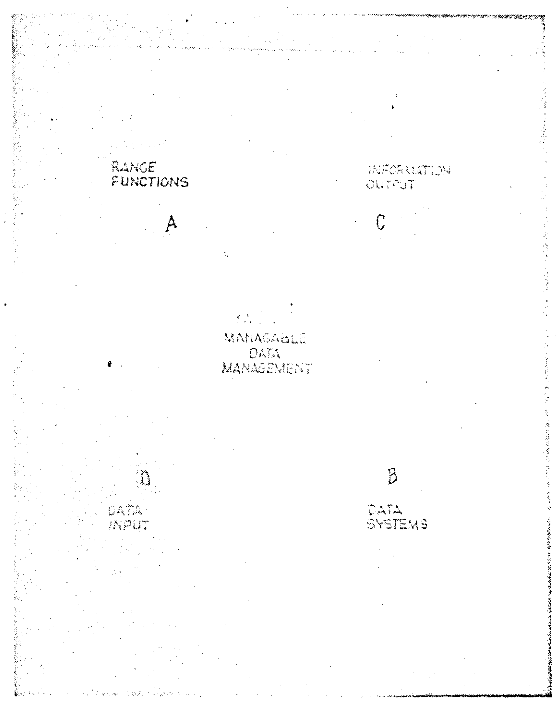


3.4.1

H/12
12/20/65

5

CRCC REQUIREMENTS

RANGE DATA SYSTEMS

RANGE FUNCTIONS	DATA COLLECTION (RADAR, TELEMETRY, OPTICS)	DATA TRANSMISSION (RADIO-M WAVE, LAND LINE)	DATA PROCESSING (REAL TIME, NON-REAL TIME)	DISPLAY & CONTROL
MANAGEMENT CONTROL				
RESOURCES			●	
CONFIGURATION			●	
SCHEDULE			●	●
PRE LAUNCH SUPPORT				
MISSION PLANNING			●	
RANGE CONTROL		●		●
SYSTEM CHECKOUT		●		●
OPERATION SUPPORT				
LAUNCH CONTROL	●	●	●	●
RANGE SAFETY	●	●	●	●
MISSION SUPPORT	●	●	●	●
POST OPERATION SUPPORT				
TRAJECTORY	●		●	
PERFORMANCE	●		●	
DATA REDUCTION	●	●	●	●

6

INPUTS

RANGE FUNCTIONS

	[illegible]	PRELAUNCH SUPPORT	[illegible]	[illegible]	[illegible]
SCHEDULE	●				
DATA REQUESTS	●				●
PREFLIGHT CONSTANTS			●	●	●
RADAR			●	●	●
METEOROLOGICAL		●			●
PCM		●	●	●	●
FM		●	●	●	●
VIDEO			●		
CINETHEODOLITE					●
⋮					
FINANCIAL	●				
LOGISTICS	●				
INSTRUMENT READINESS		●			
RANGE CLEARANCE		●			
DISCRETE EVENTS		●	●	●	
COMMAND/CONTROL	●	●	●	●	

7

OUTPUTS

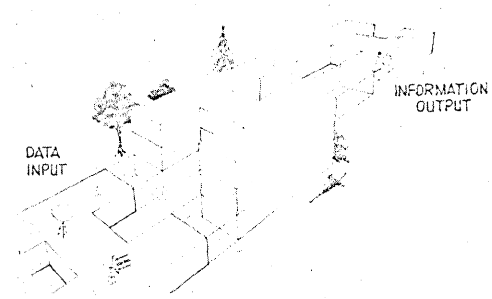
RANGE FUNCTIONS

	MANAGEMENT CONTROL	PRELAUNCH SUPPORT	[illegible]	[illegible] SUPPORT	[illegible]
PP/IIP DISPLAY			●		
STATUS CHECKOUT		●			
GUIDANCE				●	
PERFORMANCE DISPLAY				●	
TRAJECTORY REPORT					●
PERFORMANCE REPORT					●
ACQUISITION			●	●	
COMMAND	●	●	●	●	
⋮					
MANPOWER LOADING	●				
SYSTEM UTILIZATION	●				
rf ASSIGNMENTS	●	●			
SCHEDULING	●	●			

8

RANGE FUNCTIONS

MANAGEMENT CONTROL
PRELAUNCH SUPPORT
OPERATIONS SUPPORT
POST OPERATIONS SUPPORT



MANAGEMENT INFORMATION
TELEMETRY
DATA REDUCTION
REAL TIME
⋮

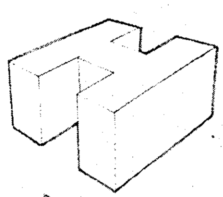
DATA PROCESSING SYSTEMS

9

10

11

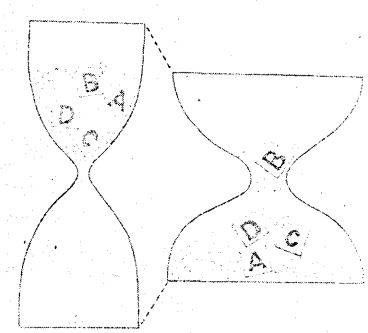
MANAGEABLE DATA MANAGEMENT



PROVIDES:	REQUIRES:
STANDARDIZATION	PEOPLE
ECONOMICAL SYSTEM	PROGRAMS
CAPACITY	PROCEDURES
RELIABILITY	EQUIPMENT
FLEXIBILITY	
GROWTH	

12

IMPLEMENTATION SCHEDULE



13

EXPEDIENT SYSTEM

- CONTINUED UNCOORDINATED GROWTH
- UNNECESSARY EXPENSE OR POOR INVESTMENT
- LESS ENGINEERING CONTROL
- LITTLE OR NO COOPERATIVE OVERLAP ON RANGE WORK
- NO SYSTEMATIC MEANS TO SATISFY OVERALL RANGE REQUIREMENT FOR DATA PROCESSING

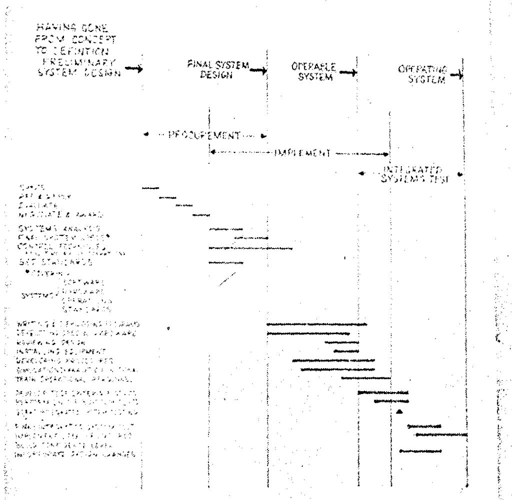
14

THE STEPS TO GET FROM TODAY TO THE RIGHT SYSTEM COULD TAKE

OVER 3 YEARS

15

BEST IN-LINE SCHEDULE



16

HOWEVER:

BY TAKING ADVANTAGE OF:

A GOOD DESIGN - PROVIDING CAPABILITY AND FLEXIBILITY FOR GROWTH

SETTING STRONG STANDARDS

WORKING DOCUMENTATION

PROVEN TECHNICAL MANAGEMENT - CAPABILITIES AND METHODS

EXPERIENCE - IN QUALIFIED PERSONNEL

PROVEN METHODS FOR TECHNICAL EXCHANGE AND APPROACHES

PLANNED OVERLAP, IMPLEMENTATION SCHEDULE

A CHECKOUT-DEBUG FACILITY WHICH:

17

CHECKOUT FACILITY

- ALLOWS SHAKEDOWN OF TECHNIQUES, METHODS, EQUIPMENTS AND PROGRAMS ON PROTOTYPE BASIS
- PREVENTS IMPACT ON PRESENT RANGE WORK AND SYSTEMS
- CAN HANDLE RANGE OVERFLOW WORK AND PREVENT CONTINUED SPENDING ON OUTMODED SYSTEMS

18

IN SHORT

BY MAKING THE DECISION TO ACCEPT A DATA MANAGEMENT SYSTEM IMPLEMENTATION PLAN

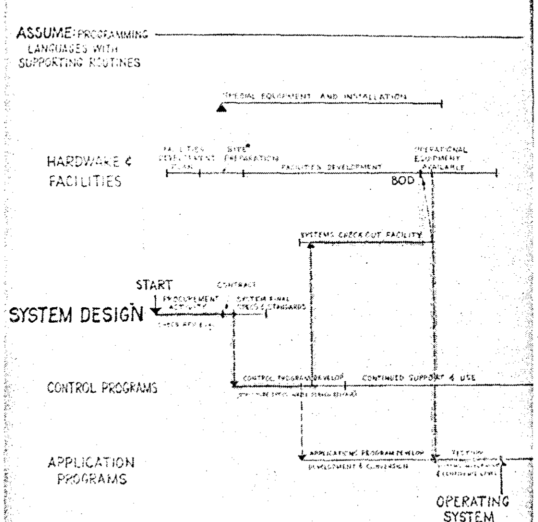
THE CAPABILITY IS GAINED FOR THE RANGE

TO ACT - INSTEAD OF REACT

TO OPERATIONAL REQUIREMENTS

19

ACCELERATED SCHEDULE



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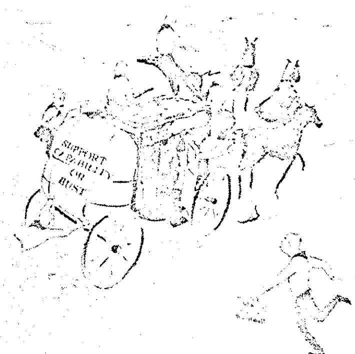


21

RECOMMENDATIONS

BEGIN PROGRAM CONVERSIONS

CONTRACT FOR PRELIMINARY DESIGN OF CRCC AND R/T CONTROL PROGRAM

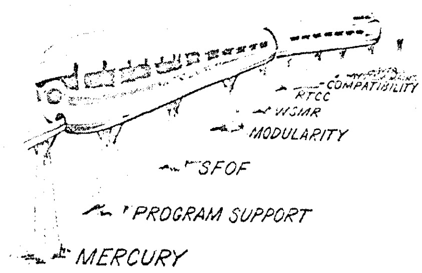
PLAN FOR SYSTEM CHECKOUT FACILITY

GENERATE SYSTEM SPECIFICATION FOR CRCC AND ISSUE RFP BY 1 MARCH 66

AWARD CRCC CONTRACT NLT 15 APRIL 66

BEGIN PERMANENT CRCC CONSTRUCTION

22



November 18, 1965

C. Tross

PART I.
TO: Distribution

COMPANY CONFIDENTIAL

TRIP REPORT: VISIT TO

On 11/16/65 the writer visited the Western Test Range and spoke with Mr. Stan Radom, Colonel Hoffman, and Mr. Hallenbeck.

The visit was arranged for the writer to re-establish his contact with range personnel and explore their current interests and future requirements for the range.

The first meeting was held with Mr. Radom. We discussed the presentation given to WTR by IBM on 11/10/65 concerning the "Integrated Control Center Study". Mr. Radom made the following comments:

1. The presentation was made at his request and he coordinated the attendance invitations to WTR personnel, which included General Bleymaier, Commander WTR.

2. He felt this presentation was generally well accepted, however, some attendees had hoped for more details and were hostile.

3. He [illegible] quite satisfied with the expressed interest on the part of IBM and especially the desire to provide the preliminary services being expended during the next month.

4. He also states that GE and CDC are conducting similar studies at this time.

5. Since some of the people were not completely sold by the presentation, a great deal of emphasis shall have to be placed on the report and possible presentation, which will take place in mid-December.

6. At the present time the ICCS is the principal thrust effort at the range. It is hoped that this center will be active and useful for the MOL program with which the range is significantly preoccupied.

Meeting with Colonel Hoffman

1. Colonel Hoffman, in effect, relayed the same personal observations as Mr. Radam.

2. Sperry Gyroscope has contacted Colonel Hoffman in regard to the ICCS but it seems they were not encouraged to participate.

3. He is quite interested in using a Multi-Station Solution in the center.

4. He pointed out that since radars cannot provide comparable accuracy to inertial platforms, range safety officials have agreed to employ platform data in range safety displays. This, he feels, is a major break through.

5. In view of the cost and weight of the transponder, Colonel Hoffman feels that GERSIS (which uses the GE-Mod III radar and COTAR) is no longer of particular importance. He thinks the range should eliminate this system.

6. At the present time an RFP is being prepared,the first version of which has been reviewed by Colonel Hoffman but was returned for revision. He thinks clarification and more detail is desired in this RFP.

Meeting with Mr. Hallenbeck

1. Mr. Hallaway reflects similar impressions to those offered by Mr. Radom.

2. He stated that ICCS mission definition is not very clear at this time. Although a number of range personnel are addressing this problem, no definitive definition exists at this time.

3. Mr. Hallenbeck elaborated on his job and responsibilities. He reports directly to Colonel Hoffmann and is responsible for the engineering budget. At this time he is occupied with the preparation of the FY'67 budget.

There are three fundamental and distinct budgets at WTR which may not draw on one another. He did not offer any information as to budget magnitude, however, stated " It is much more difficult to obtain money in the Air Force than it was in the Navy." "If you think we had it bad at the Navy you should see it now."

Distribution:

C. B. Brown
Dr. P.A. Castruccio, Bethesda
E. Doyle, Bethesda
R. G. Finnegan
W. B. Gibson
J. E. Hamlin
J. P. Jones
P. E. Lindfors

CT:jh

PART II November 18, 1965

To: Distribution

From: C. Tross

Subject: Trip Report - Visit to PMR

On Nov. 17th I visited Mr. Henry Settle at PMR. A general discussion was held pertaining to his current efforts and interests. He stated that:

1. The RTDHS programming task is currently being executed by Informatics under a $90K contract won as a result of a select source competition in March 1965.

2. Integration of RTDHS and IDDS is being effectively conducted by Collins and Range Development personnel.

3. The RTDHS-IDDS control center has been designed and will be located in Bldg. 50; it is intended to be a rather comprehensive center.

4. The ROMAC program has now been completed by ITT. Equipment for this system has been received and integration is scheduled to be undertaken by Range Operations personnel.

5. The range is currently interested in activities related to the Pacific Test Range and the Hawaiin Undersea Test Range.

6. For the moment, Settle knows of no new systems development plans. He suggests, however, that we contact Dr. Dudsziack in Santa Barbara (formerly with TEMPO), who is still a principal test consultant with substantial influence at DASA. He feels that new support-type programs may be in the making.

7. Mr. Settle gave me copies of Informatics report on RTDHS and Collins report on IDDS/RTDHS. These reports should be helpful in RICC.

C. Tross

IBM CONFIDENTIAL

November 3, 1965

TO: Mr. J. J. Selfridge

FROM: F.X.O' ourke

INITIAL THOUG S CONCERNING IMPL ENTATION OF THE DIGITAL CHECKOUT FAC TY AT THE WTR LAU H COMPLEX.

In an area as comp ehensive and overs vehicle checkout and validation, the writer cannot ne to initive recommendations on the subject unt as i a greal deal more specific engineering information regarding pla equ nt configuration, proposed test and checkout approach, as well as the general operational criteria associated with the launch of the particular vehicle. This data, coupled with specific launch objectives and broad launch schedules, would allow the presentation of system engineering ground rules more directly geared to insure the orderly rapid and successful development of a useful computer checkout complex facility.

However, it is the writer's opinion that experience gained in designing and implementing a job such as a launch control system for the Apollo launch vehicle has highlighted some very pertinent general engineering considerations which should be carefully taken into consideration in the development of any hardware/software checkout capability to be used for validation of Apollo or Titan type vehicle. While many of the following recommendations can easily take on the aspect of self-evidency or patently good engineering procedure, the writer would like to stress that most of them were completely overlooked in the initial design of the existing Saturn launch computer complex and, in many cases have deteriorated the utility of the system to such an extent that formal engineering notification has been transmitted by IBM to NASA expressing the high probability that the existing launch computer complex will be unable to launch a Saturn V vehicle without a material modification to the system either through the additional computer capacity or the relegation of prime control functions to ground support hardware in place of the Saturn launch control computer.

Assuming, for this discussion, a checkout and launch facility is required for the Titan III vehicle and that some semi-automated computer checkout capacity is desired, the following ten basic ground rules should be thoroughly investigated prior to layout of the initial system configuration:

1) Operational experience being gained now at launch complex 34 and 37 clearly highlights the undesirability of a two-computersystem with one computer very close to the vehicle and the other in the blockhouse. In practice the existence of a completely implemented computer facility close to the vehicle has proved very difficult to utilize during the final pases of the

countdown and in event of failure or misoperation leaves the operational launch control group completely helpless to take remedial steps for even the slightest malfunction, since the launching procedures allow no person in the area during final phases of the countdown. As a result of this problem, every effort is now being made in the Saturn facility to remove all major control and test programs from the computer located nearest the vehicle in such a manner that in the final phases of countdown the vehicle (AGSC computer) is in a passive monitor status with as much control as possible relegated to the blockhouse computer. While complete discussions of this particular problem are outside the scope of both the paper and the time writer has to prepare it, the basic criteria of limiting computer hardware as much as possible to those input and output devices required to fee the central control processor cannot be overemphasized if the checkout system is planned for use during a launch countdown.

2) Evidence clearly indicates that even checkout systems, utilizing computers, starting out with the purest intentions of remaining completely passive at some time in their development require the generation of control functions from the checkout computer to the launch vehicle system under test. The insertion of this control capability into the checkout computer system will rapidly evolve into a basic requirements (generated by range operational personnel) to utilize the computer system as an active control element during launch operations. If this possibility exists, care should be taken in the initial design of the computer facility to provide adequate high-speed data channels to allow the full potential of the computer facility to be eventually realized. As a minimum, means should be provided in the data link communication system from the computer to the vehicle to allow all control functions to be transmitted completely independent of monitor functions and data being transmitted from the vehicle to the computer. As a minimum, it would seem this would take the form of separate

IBM CONFIDENTIAL

IBM

Date: January 17, 1966
From (Dept Loc): L.A. Westchester GEM - 230
Telephone Ext.:

Subject: CTCS - WTR

Reference: Your memo to H.G. Hoyt, 1/4/66

To: Mr. J.E. Hamlin
MOL Project

Due to delivery requirements, the Universal Telemetry System RFP for CTCS will be no-bid. A technical report will be submitted to Col. Hoffman, Director of Range Engineering, describing a system that would meet the technical requirements of the RFP. The purpose of the report will be to delay delivery requirements and to demonstrate IBM's capability in this area. Target date for submission of the report is January 25, 1966. Presentations by F. Mutz and myself upon submission are also planned to further strengthen our recommendations.

It is expected that WTR will also be letting an RFP about Feb. 15, 1966 for a computer system to perform "fault analysis" and control of the entire CTCS facility. Personnel knowledgable in telemetry processing are presently being sought within IBM to meet this and future telemetry bids at WTR. Subcontracting or teaming arrangements are not recommended due to the extreme need of building and retaining in-house capability in this area.

J. Priday

J. Priday

JHP:ep

cc: H.G. Hoyt
P. DePascale
J. Warstler
F. Mutz, FSD
W. Gibson, MOL

MEMORANDUM TO FILE

FROM: J. E. Hamlin

SUBJECT: Trip Report on Visit to MCC - Houston, with Major Hartrim and 'st Lt. Smith of the 6595th Test Wing

Major Hartrim requested that IBM personnel accompany him and Lt. Smith on a visit to Houston Control Center. I advised him to make arrangements through military channels. The visit was made with myself and Mr. Jay Priday of the Data Processing Division accompanying Major Hartrim and Lt. Smith.

During the flight down, we discussed the general agenda, which covered the following items:

Trajectory calculations

Simulation

Crew environment data

Post flight data reduction

Programming system design, particularly how changes were incorporated

Brief discussion on the tradeoffs of the relative costs of space, between office space and that for electronic equipments.

We met in Houston at the Alpha Building on Monday morning at approximately 9:00 a.m. We had a brief discussion and Major Hartrim checked with Colonel McKee's office and determined that he had failed to make proper arrangements through military channels and so some time was wasted in military protocol. We did, however, meet a Colonel Ballantyne, who is the MOL coordinator for the Space Systems Division of the Air Force at Houston, for working relationships with NASA. I gained the impression that in this capacity, Col. Ballantyne works for a General Burke. Mr. Priday and I toured Major Hartrim and Lt. Smith through the Control Facility. Lt. Smith is a little difficult to work with, in that he interjects questions and engages in give and take discussion. However, we did manage to describe the operational aspects of the control center, the data flow, the functional use of the computers and some of the other features. Smith engaged in conversation as to relative merits of display system. I don't think we did too good a job in describing to him the reasons behind the design. He was openly contemptuous of some of the design that he found in Houston, making statements such as the Air Force would surely want a system that was simpler in design or more efficient in operation. I judged that Major Hartrim is a real strategist. He has been in the Air Force a length of time and before that told us that he had been an enlisted man in the Navy. He described how the CTCS system came to be established, wherein they had taken common equipment from each launch complex and consolidated it into one facility. He described the fashion in which he had obtained SAC cooperation to provide the building, by promising them the system when it became operational and how, later, he arranged to have a higher level command renege on the obligation. He described further how it had been planned to turn over this facility, which was inadequate to the WTR, such that the Wing would be free to procure the TMCC. He went on further to describe that the Wing had money for a TMCC and had preliminary design in mind; he described that the TMCC would be implemented in a step-by-step phasing manner and that it would be done in order to support the MOL. Clearly, there is a need for additional marketing to be done in the area, and we must learn more details about the organization of the Wing.

Major Hartrim did say that the Commanding General of the Wing, Colonel Newton and his deputy, I think a Colonel Greede, were retiring. He and Colonel Ballantyne had discussion on this point, on the relative difficulty of keeping competent military officers in the Service when they were no longer qualified for flying status.

I think much of the discussion was for the benefit of we civilians who were standing there who they obviously believed made too much money.

Major Hartrim said that the CTCS computer bid had been killed but that some of the people on the base had not been advised of this yet. Both Hartrim and Smith portrayed a feeling of self-sufficiency on the part of the Wing. They indicated that they had had discussions with CDC but not any great amount of discussions with UNIVAC. He further said that they had had very little or no discussions with Philco. He was amused by the fact that the majority of the contractors and vendors have given attention to WTR and have overlooked the Wing. We determined that the TMCC would not include the range safety function nor normal data reduction. We also determined that the TMCC would be oriented from the standpoint of telemetry data input and data reduction and mission control, as derived from telemetry-type data. They are specially interested in checkout. Their concept is that the TMCC would have a central type of data handling and computing and that the launch control would be obtained by remote display that could be fairly flexible or movable and the driving distances from the Control Center TMCC to the launch display might be in the area of 5 miles. They gave strong emphasis to the minimalization of equipment throughout the total system. They, in my judgement are looking for a fully integrated system and a single contractor. At this point I believe, from my discussions with them, that they would recommend both hardware and software in one contract. They implied an RFP in approximately three months. They said that the TMCC building was actually underway.

They will have further discussions with Philco in Houston on the Control Center and after that plan to go to Cape Kennedy, where they intended to tour the Merritt Island facilities and the Control Centers on Cape Kennedy. They might also have planned to go to the Data Reduction Center at Patrick.

I believe it would be profitable to get back for further discussion with Major Hartrim in the area of checkout and in the areas of launch control. I think that he and Smith would be quite candid in terms of what their system design approaches are. I am sure that they have a very close working relationship with CDC. This was indicated by the fact that the CDC salesman, a Tom Gorman, was with these gentlemen Sunday afternoon at the time they ordered the airplane.

GEM Region
Air Force Programs
Washington, D.C.

December 2, 1965

MEMORANDUM

TO: Mr. W. B. Gibson
L. A. Aerospace Building

SUBJECT: Western Test Range

I have learned that plans to merge the 6595th Aerospace Test Wing into WTR have been scrapped. WTR will take over some of the space in the building which houses the 6595th.

National Range Division is aware of WTR's present study of CRCC, and will be interested in seeing the results of their study. In order to sell a program for CRCC to NRD, WTR's pitch should show WTR as a component part of the larger Global Range System which includes ETR and SCF. Great care should be taken to show how easily WTR can interface SCF and ETR, and where system compatibilities can be effected.

R. P. Bruns

RPB:ils

cc: Mr. J. W. Richardson

December 8, 1965
L. A. Westchester GEM - 230

IBM CONFIDENTIAL

Weekly Activity Report on WTR Project
12/3/65

H. G. Hoyt
Branch Manager

Calls were made on Gene Clary, John Payer, Major Olson and Dave Huffman by Bill Gourlay, Gene Rogers and Dick Stanley. Purpose of the calls was to gather information on installed Data Handling System and Communication System. Documents were obtained to assist in documentation of present system.

Meeting with Major Conley, Chuck Leroy, and various people from the Command and Control section of Range Engineering was attended by Dave Nichols, Michel Bibault and Jay Priday for discussion of the WTR project and in particular the Management Information System of the project. In addition to the discussion on the local requirements for Management Information System, it was learned that $4,000,000 was planned for the military construction program at WTR for the fiscal year '69 for a Consolidated Range Control Center. Installation of equipment into the CRCC is planned for fiscal year '70. This represents a one year slippage in previous plans. Major Conley also indicated that the Consolidated Telemetry Checkout Station will be turned over to WTR on 1 January 1966. Finally, it was learned that the preliminary Range Package Plan that was submitted to NRD November 15 will be back to WTR on December 15. At this time the Range will prepare the final version of the long range plans and submit the final version to NRD on January 15, 1966. The Range hopes to incorporate into this planning document information that we submit in our technical reports on the Consolidated Range Control Center.

Timing kernels were submitted to Jim Alexander, Range Operations, comparing the 7094 Mod 1, 7094 Mod 2, 360/65, and 360/75 on a representative scientific job mix. These kernels were taken from the Force proposal that was prepared by the Federal Region and Poughkeepsie groups.

The Fall Joint Computer Conference was attended by Bert Lary, John Spellman, and Jay Priday. Bert Lary is in the Systems Engineering group of Range Engineering and John Spellman is an engineer for the Autonetics Division of North American and is active as a consultant to both the Western Test Range and the 6595th Test Wing. A special demonstration of our 360 system at the conference was arranged and discussions on the Consolidated Range Control Center were accomplished at the conference.

Mr. Frank Mutz, formerly FSD Project Manager at JPL, is now FSD Project Manager at the Western Test Range. Mr. Mutz arrived in Lompoc on Friday and started to familiarize himself with the project.

A preliminary telemetry systems design was started by Paul Lindfors, Bill Fulton, and Jim Hamlin. Mr. Fulton is a consultant hired by FSD for the telemetry design.

A preliminary outline of the technical report to be presented to the Western Test Range was prepared by Dick Stanley and Jay Priday. Following are the major subject areas for the report:

Executive Summary
System/360 Hardware
System/360 Software
Data Reduction
On-Line Real Time Operational Support
Telemetry System
Communications
Instrumentation Checkout and Diagnostics
Management Information System
Detailed Systems Design
Hardware Cost
Software Cost
Physical Planning
Facilities

Target date for submission of technical report to the Western Test Range is December 15, 1965. Maximum effort will have to be expended by project team in order to meet this target date.

Jay

J. H. Priday

JHP/mb

cc: Paul DePascale, LSG
Bill Gibson, MCL

IBM

Date: February 10, 1966
From (Dept Loc): L. A. Westchester GEM - 230
Telephone Ext.:

Subject: MOL Planning at Vandenberg AFB

Reference:

To: W. B. Gibson
MOL Project

Plans for supporting MOL are now under way at Vandenberg AFB by both the Western Test Range and the 6595th Aerospace Test Wing. Range safety and communication of orbital parameters to the mission control center will be the responsibility of WTR. Pre-launch check-out of booster and vehicle, simulations, and biomedics are requirements that the 6595th are now planning for.

WTR will perform their functions on the existing 7094/7044 system. Processing of radar data will be performed by the 7044 while the guidance data from the telemetry system will be handled by the 7094. No firm plan is now in existence if redundancy of computing systems is a requirement. Discussions with WTR personnel indicate that if redundancy is a requirement, four alternatives will be explored:

1. Duplication of existing 7094/7044 system.

2. Replacement of present systems with a dual 360/40 or 360/65 configuration.

3. Replace the 7044 with CDC 3600's to handle all real time requirements.

4. Provide real time inputs to both 7094 and 7044 and essentially split the system into two separate computing systems.

Extreme pressure is now being exerted on WTR from NRD to install the 3600's so that standardization of computing systems at ETR and WTR can be accomplished. WTR is taking the position that the Range is meeting its real time and data reduction requirements on a single direct couple system and hence, additional computers are not necessary. In fact, current plans are fairly firm to award FSD a sole source contract to provide WTR with a software package to incorporate present real time and non-real time programs into a DC system similar to the one at White Sands.

Duplication of present DC system to meet MOL requirements is rather remote unless systems within the government's inventory are available.

Replacement of existing systems by third generation equipment could be effected by an RFP late this year with installation date FY '68. This would be in line with WTR's plans to relocate and consolidate all Range computers into a single Consolidated Range Control Center (CRCC). Approval for the CRCC depends on whether or not the 6595th gains approval for their planned Technical Management Control Center (TMCC).

Splitting the two systems and giving the facility some resemblance of redundancy is not favored due to increased cost in both hardware and software without an appreciable increase in capability.

In the area of pre-launch check-out, etc. the 6595th is moving very rapidly to gain approval for the TMCC. About $2.5 million has already been approved for a building and approval for equipment money is now being sought from General Shriever. Presentations by the Test Wing and local Aerospace Corporation personnel to General Shriever was supposed to have taken place during the week of 2/4/66. Concept approval has supposedly been obtained from General Cooper and General Bleymaier.

Specifications for an RFP are now being generated by personnel from the Test Wing MOL Project Office (Major Hartrim and Lt. Smith). Hartrim and Smith toured various facilities in the country during the week of 2/4/66, looking at design approaches and contractor capabilities. Jim Hamlin and I accompanied Hartrim and Smith to Houston, where we toured the RTCC. The following information was obtained from the trip:

1. Approximately $20 million is available for the TMCC.

2. If approval is obtained, an RFP will be out in the second or third quarter of this year.

3. A single contractor for system design, hardware, software, integration, ONM, etc. is mandatory.

4. Design will call for five telemetry processors to perform the decommutation and data compression functions.

5. Two main processors to perform the data analysis and display formatting will also be called for.

6. A telemetry oriented software system, similar to STOLL being developed for the CDC 924 at Douglas Aircraft, is needed.

7. The TMCC will be used for all MOL work at WTR. No special contractor-provided systems will be allowed.

8. The function of the Consolidated Telemetry Checkout Station (CTCS) presently being run by WTR for pre-launch check-out of ballistic weapon systems will be transferred to the TMCC with the result that CTCS will no longer be needed.

9. CDC will probably be bidding five 1700's and two 6400's and Hartrim and Smith lean toward their approach. The WTR CDC representative, Pat Gorman, accompanied Hartrim and Smith to the L. A. Airport.

10. Philco is not held in very high esteem by the Test Wing. Lockheed's status unknown at this time.

11. Hartrim and Smith were planning sessions with Philco in Houston, CDC at the Cape, and GE in Philadelphia, on their trip.

12. Approximately twelve CRT displays and associated control equipment will be required per launch complex. There will be approximately eight to ten such complexes needing this capability.

13. Equipment deliveries will be in the early 1968 time period.

It must be emphasized that the above information was obtained from local Test Wing personnel. No information is available at this time at the SSD or AFSC levels to verify the above is being done by the 6595th. Although it was indicated that General Bleymaier had approved of the TMCC concept, talking with local Test Range personnel indicates no decision will be made on the TMCC until organizational problems are ironed out between the Test Wingand WTR.

In the event, however, that the Test Wing does gain early approval for their plan, the following marketing plan has been established:

1. Perform preliminary system design. This includes design philosophy, standard and special equipment needed, RPQ's, and special CRT displays.

2. Establish software requirements, including special telemetry oriented language. Presentation of the telemetry software system proposed at White Sands is planned in the near future for Test Range personnel.

3. Establish a preliminary implementation plan - one of the tough ones. Define areas in which IBM has the capabilities and discuss teaming relationships for that part of the plan where IBM has no capability.

4. Determine equipment availability.

5. Arrange for hardware/software presentations at Poughkeepsie plant.

6. Obtain comparative analysis of expected CDC system.

7. Obtain SSD thinking on TMCC concept.

The above marketing plan should be accomplished by April 1, 1966.

J. H. Priday

J. H. Priday
Account Representative

JHP/mb

cc: R.P. Bruns, Wash.
H. G. Hoyt
P. A. DePascale
J. E. Warstler

IBM CONFIDENTIAL

GEM Region
Air Force Program
Washington, D.C.

February 23, 1966

MEMORANDUM

TO: Mr. M. J. Priday
Los Angeles Westchester GEM

Mr. John Warstler
Los Angeles Westchester GEM

SUBJECT: Consolidated Range Control Center - WTR
Technical Management Control Center - SSD Aerospace Test Wing

As you are aware, determination of which organization will proceed with establishment of its control center will be made at General Schriever's level. A group from WTR is scheduled to brief HQ NRD during the week of February 28, in order to prepare General Davis' staff for selling WTR's CRCC to Schriever. This parallels the recent action of the 6595th Aerospace Test Wing in taking their justification for TMCC through SSD to General Schriever.

The consensus of opinion at HQ NRD now is that

(1) there is considerable economy to be gained by establishing a CRCC;
(2) the CRCC should be managed by WTR very much in accordance with present philosophies, i.e. that WTR provide standard services, facilities and data to users;
(3) the CRCC building should provide space for Range users, like the 6596th, where the user provides his own equipment for satisfying mission-peculiar requirements.

Certainly there is something to be said for NRD's approach. Consolidation, centralization and sharing of facilities will satisfy those concerned with budget pressures. Management of the facility by WTR is within the presently stated mission of WTR, hence no organizational changes would be in order. Finally, the user would have an avenue to provide his own capability when mission requirements dictate such.

I will continue to follow this project at NRD HQ, and advise upon on its program.

R. P. Bruns

RPB: mr

cc: Mr. H. G. Hoyt, B/M, Los Angeles West. GEM
Mr. P. A. DePascale, Los Angeles West. GEM
Mr. W. B. Gibson, Los Angeles Aerospace MOL
Mr. J. W. Richardson, Local

IBM CONFIDENTIAL

GEM Region
Air Force Program
Washington, D.C.

March 7, 1966

MEMORANDUM

TO: Mr. J. Priday) Los Angeles Westchester GEM
Mr. J. Warstler)

SUBJECT: Consolidated Range Control - WTR
Technical Management Control - SSD 6595th

Determination of which organization should proceed with its plans to establish a control center will be made in a few days. As I indicated in my February 23 Memo, NRD favors the WTR managed CRCC. It is very clear, however that NRD's support of CRCC at General Schriever's level will not be particularly strong. According to Colonel Creighton, assistant to the Commander, NRD is 51 % for CRCC.

It is clear then, that we must continue to concentrate on influencing the 6595th at Vanderberg as they develop specifications for the TMCC.

R. P. Bruns
R. P. Bruns

RPB:mr

cc: Mr. H. G. Hoyt, B/M, Los Angeles Westchester GEM
Mr. P. A. DePascale, Los Angeles Westchester GEM
Mr. W. B. Gibson, Los Angeles Aerospace MOL
Mr. J. W. Richardson, Local

IBM
CONFIDENTIAL

MOL STANDARDIZED CALL/TRIP REPORT

Customer/Prospect Name (1) IBM, Lompoc, California (15)

Individual(s) contacted (16) F. Mutz, R. Ursin-Smith, W. Green, W. Grisham, J. Gray, R. Hippe (59)

Your Name (60) W. Gourlay, F.X. O'Rourke (70) Date (71) March 24-25, 1966 (76)

Summary of Facts Covered:

1. An orientation and direction conference was held on March 24-25, 1966, at the Lompoc Office, regarding the AFWTR Consolidated Range Control Center (CRCC), the AFWTR Consolidated Telemetry Checkout System (CTCS), and the 6595th ATW Technical Management Control Center (TMCC).

2. Integration and organizational reassignment of F. X. O'Rourke and W. Gourlay, Jr., from Department M48 to Department M49 was discussed between F. Mutz and the principals involved.

3. As a subset of the effort in automatic checkout, a demonstration (simulation) on the IBM 2250 is desirable. D. Lee and J. Gray are assigned to program the demonstration, with half-time programming assistance from P. L. Hertan. D. Lee and R. Cabaniss are presently programming a demonstration for the USAF Satellite Control Facility. It is expected that much of this experience will be directly applied to the checkout simulation. R. Hippe is addressing the problem of availability of a machine for the demonstration. Preliminary display simulator requirements reflecting the concept contained in the Preliminary Design Specification document have been completed. These simulation requirements are in sufficient detail to warrant a complete review with the assigned programmers prior to finalizing the approach.

4. The USAF political situation at Vandenberg AFB was briefly touched on. It was decided to address the general need for an integrated modular approach to the next generation of "on line" aerospace ground computer complexes, while maintaining a capability to respond to either a total or segmented specification as required.

5. Summary
   a. The display specification for the Simulator is in sufficient detail to commence the initial programming effort.
   b. Equipment availability is unresolved at this time and will have important effect on the entire schedule.
   c. Content of simulation demonstration will be determined by March 30, 1966.
   d. D. Lee and J. Gray are assigned to program this demonstration. P. L. Hertan will be assigned to assist on a half-time basis about 3/30/66.
   e. F. Mutz and R. Hippe have reviewed the initial simulator concept and are in general agreement.
   f. The goal of this group is to have initial flow charts and coding well under way by April 1, 1966.

W Gourlay Jr

W. Gourlay Jr.

WG/jh
cc: C. B. Brown, J. Gray,
W. B. Gibson, R. Hippe, F. Mutz

L.A. Westchester GEM - 230
April 12, 1966

Memo to: R. P. Bruns, GEM Region
P.A. DePascale, LSG
W. Gibson, MOL
H. G. Hoyt, LSG
F. E. Mutz, FSD
R. K. Rea, LSG
J. W. Richardson, GEM Region

Subject: Consolidated Telemetry Checkout Station (CTCS) at Vandenberg AFB

An RFP is expected within the next 30 days from the Western Test Range (WTR) for a telemetry system to perform pre-launch checkout of ballistic missile systems launched from Vandenberg AFB.

Due to the complexity of the proposal and the severe impact that it has on IBM's future at Vandenberg, this memo is being written to define in detail the situation that exists so that the various IBM offices involved can be kept abreast as to the status of the project, our plan of action, and the support we expect to solicit in order to win.

The CTCS was conceived and developed by the 6595th Aerospace Test Wing, located at Vandenberg AFB, to bring about a better cost effectiveness approach to the function of pre-launch checkout of missile systems. The purpose of the CTCS is to provide a common set of equipments, in a single facility, and available to all range users to perform the pre-launch checkout of their respective missile systems. This consolidation has taken place in the area of ballistic system checkout and as of January 1, 1966 the facility was turned over to the WTR for operation. The 6595th is now planning for a multi-computer complex called the Technical Management Control Center (TMCC) to provide a capability for performing the checkout of not only ballistic systems, but also all space systems including Titan III and MOL. The CTCS will eventually be replaced by TMCC and equipments compatible with the design approach of TMCC will be transferred. In fact, all future procurements for CTCS, including the expected above-mentioned RFP, will have to be in line with the TMCC design. It is essential, therefore, that we win the upcoming CTCS RFP. It has not been resolved as to who will control the TMCC, either the 6595th or the WTR, but in any case our strategy remains the same no matter who wins control.

The CTCS RFP will be a total system bid that will include computers, special telemetry equipment, software, and system integration. The RFP is expected by May 1, 1966 and will call for a 30-day response, a 30-day evaluation, and equipment delivery 225 days after contract award. The range is now considering purchase of all equipment with approximately $1.35 million of FY66 money available for this procurement.

Information from the range indicates that the specifications will call for computers with a 1 μsec memory cycle and 24 bit or greater word length.

Preliminary system design using a dual Model 44 configuration is shown in the attachments. Purchase price for this system is approximately $1.2 million and this does not include special front end equipment, software, or system integration. At this time we do not have a dollar estimate on these additional items, but it is evident that we exceed the budgeted dollars by quite a bit. At this time work is being performed to reconfigure the system and reduce the overall cost. In addition, a single Model 44 configuration is also being studied to determine its effectiveness on the CTCS requirements.

A block diagram of the hardware system that is expected in the RFP is shown in the attachments as well as the functional requirements for the system. It is not known at this time as to what software specifications will be included in the RFP. Local SDC personnel are working on software specifications and it is expected that they will write performance specifications similar to the approach taken at the SCF for the telemetry processing.

In the area of front end processing FSD's Engineering Lab is investigating the use of a ROS system to perform the frame sync, subframe sync, limit checking, etc. The system is called the Adaptive Microprammed Control System (AMCS) and it appears to have significant application in the area of telemetry processing. Engineering Lab personnel have been briefed on the CTCS requirements and are presently performing a preliminary system design using the AMCS and Model 44's. In order to consider the AMCS, commitments by FSD on delivery, and costs will have to be obtained within the next 30 days.

Competition will come from both computer manufacturers and the special purpose telemetry industry. Following are the manufacturers and systems that are known to be actively pursuing this bid:

CDC - 1700, 3100
SDS - 92, 930, Sigma 7
DEC - PDP8, PDP7
Telemetrix - 670
Beckman - 420

This will be the second procurement the WTR has had for CTCS this year. We were forced into a no bid decision on the first procurement due to a 90-day delivery requirement and the unavailability of the 1800. Lear Siegler won this procurement with a PDP8 and Telemetrix front end equipment. It is expected that our toughest competition will again come from Lear Siegler who will be bidding a PDP system, and CDC with their 1700.

Due to the total system aspect of the RFP, FSD will be submitting the proposal. The proposal will be a joint effort by Vandenberg DP and FSD personnel and FSD's Engineering Laboratory technical staff. A summary of the tasks to be performed by this group and their scheduled end dates are shown in the attachments.

Our proposal strategy to date is to design a system that meets both the CTCS and TMCC requirements with the compatibility of System/360 providing the vehicle for growth. Both requirements will be addressed in the proposal along with the unique features and capabilities of the AMCS and a display-oriented checkout language now under development.

The major problem that now exists with the preliminary design is the cost of the dual 44's. We hope to overcome this by urging rental of the computing systems so that the budgeted dollars can be spread over many months, or proposing an alternate approach of using a single Model 44 with the front end AMCS's performing a major portion of the processing.

J. H. Priday

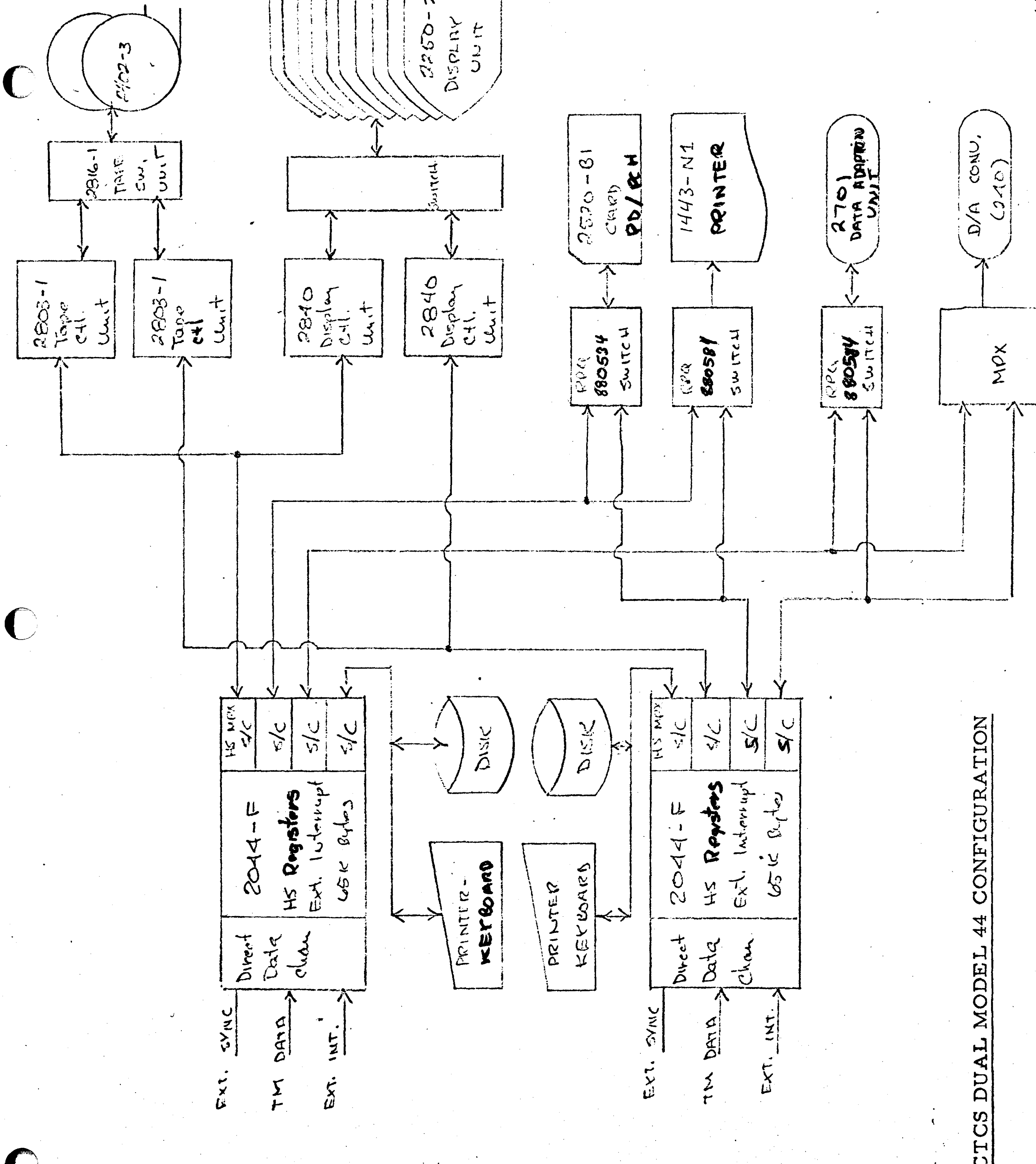
J. H. Priday

JHP/mb

cc: J. Warstler, LSG

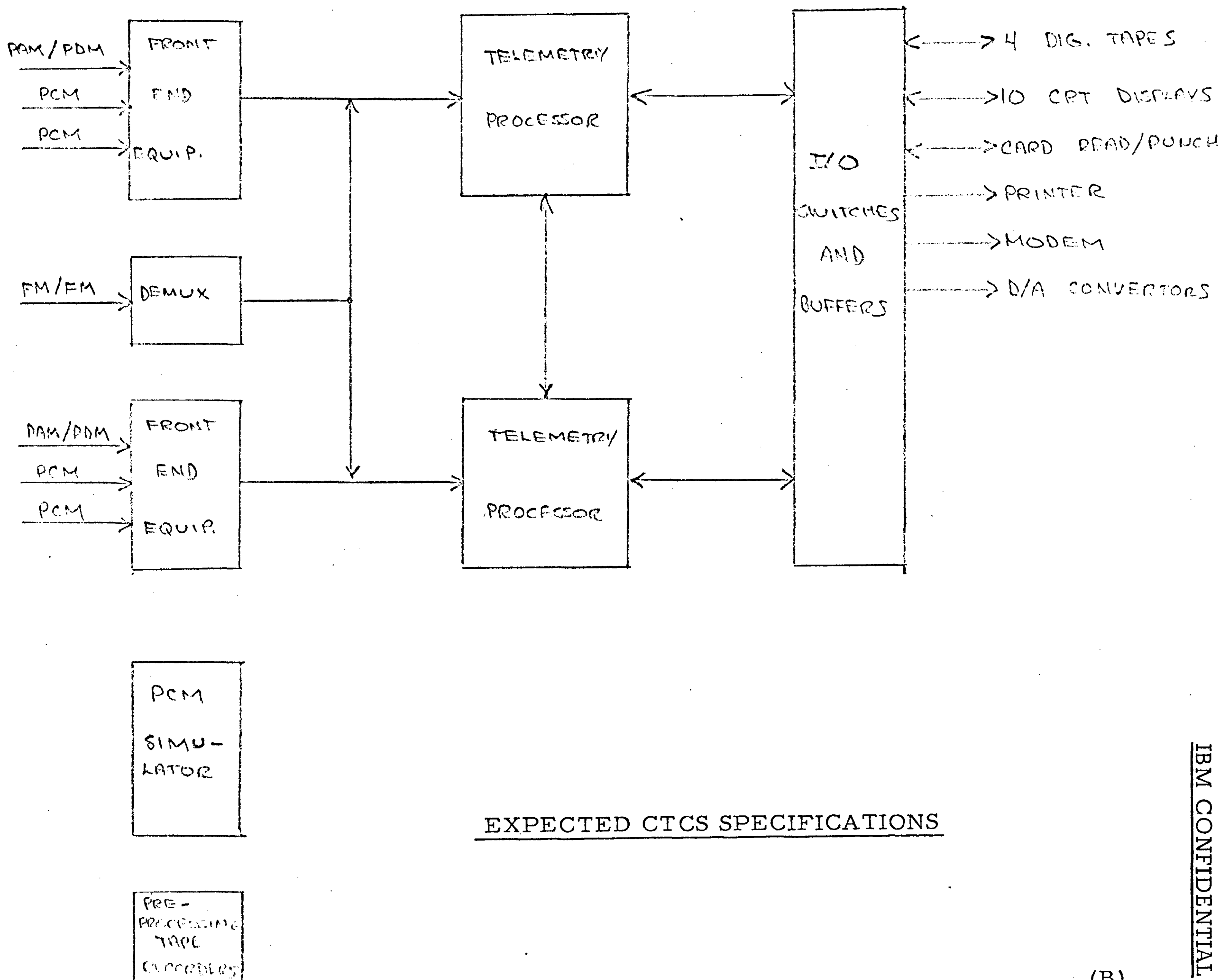
Attachments A-D

(A)



CTCS DUAL MODEL 44 CONFIGURATION

(B)



EXPECTED CTCS SPECIFICATIONS

FUNCTIONS

Inputs	Front-End Data Handling	Pre-Processing	Central Processing	Outputs
PCM PAM FM/FM PDM (See List of Involved Formats)	Signal Conditioning Signal Simulation Bit Synchronizing Demultiplexing Discrimination Analog Recording Data Distribution	Frame Synchronization Subframe Synchronization ID Validation Limit Checking Data Selection Formatting Decommutation Data Distribution Front-End Control	Linearizing Scaling Normalizing Conversion Trend Analysis Discrete Evaluation Display Generation Inquiry Response	Volatile Displays Parameters to Range Safety Strip Chart Recording
(Range Equipment)	(Vendor Supplied)	(AMCS)	(Mod 44(s))	(2250 & Modem) (Range Equipment)

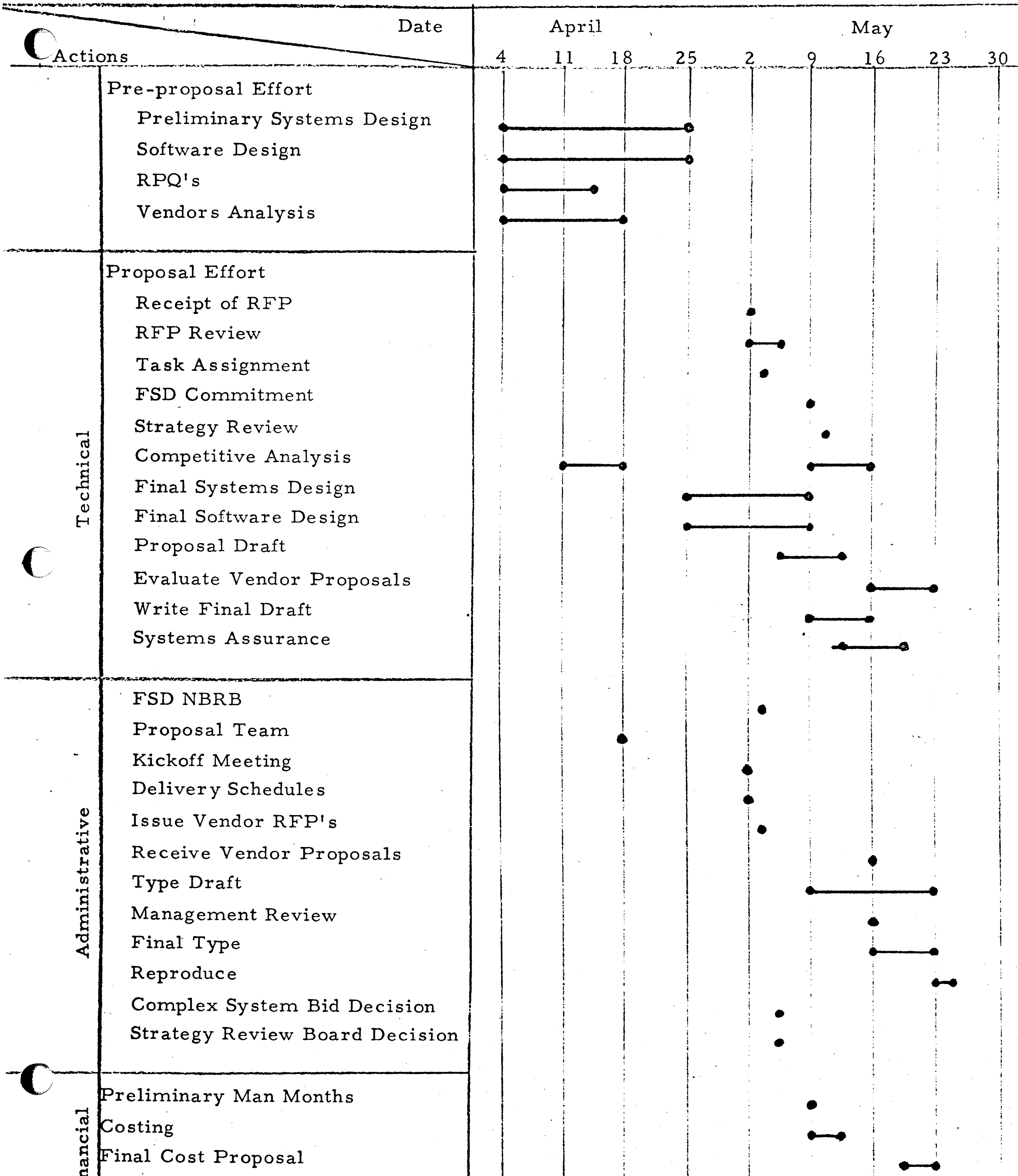
Boundary of System to be Procured

FORMATS

Minuteman	RMV-B	MTRV
Titan II	RMV-C (S Band)	MK 17
Atlas D	LTV (Terse)	EPV
Atlas E/F	MK 12	SIMPAD
MBRV	MMRBM	BGRV
RMV-A	LPTV	MIRV
	SCOPE	

(C)

TASK SUMMARY FOR CTCS PROPOSAL



IBM CONFIDENTIAL

April 14, 1966

ACTIVITY SUMMARY, Week Ending April 15, 1966

TO: F. E. Mutz/ R. W. Hippe

FROM: F. X. O'Rourke

Item 1: Simulation requirements for the initial 2250 checkout display presentation have been finalized and are ready for initial flow charting and coding. As of April 14, 1966, actual programming has not been initiated. A minimum of six weeks should be allowed for coding and checkout after assignment of one full-time programmer (familiar with existing 2250 utility routines). Assuming this programming support is available prior to April 30, the earliest reasonable date to schedule a formal presentation would be the second or third week in June.

Item 2. Presentations have been made to TMCC Air Force personnel (Major Hartrim, Lt. R. Smith, et al.) regarding TMCC System/operator interface hardware. Specific technical document have been presented to this group to highlight IBM's background and experience in the checkout and monitor field (referenced to the APOLLO program). It is apparent the TMCC group is in the process of gathering data from which they hope to define a general approach to the unified checkout concept. From what little technical information was presented by this group to IBM, it is apparent the effort will encounter almost insurmountable practical and political problems in obtaining contractor concurrence, as long as the concept stresses the use of a common computer facility. It was the writer's impression that the group is relatively weak in the computer/checkout/operator language background, required to adequately justify their concept, not only to the Aerospace Corporation but also to the contractors who would be intimately involved in the results of this effort.

Item 3: A general checkout discussion was held with Aerospace Corporation in Los Angeles on Friday, April 8, with Mr. J. O'Bell and Mr. Bavin. This meeting was very well received by Aerospace who expressed a high degree of interest in our checkout approach and stated it was essentially the same as their recommendations now being presented to TMCC personnel at Vandenberg. They were extremely interested in the ROS concept and expressed an active desire to further define, in engineering detail, hardware considerations involved in using the ROS as a front end "peripheral processing device" for telemetry data input.

Activity Summary, Week ending April 15, 1966

Item 4: An informal discussion of the unified checkout concept and the 2250 display system was scheduled with Colonel Pierce SSGS in Los Angeles on Thursday, April 14, 1966.

Item 5: Initial preparations have been initiated by this group to participate in a two-day technical seminar to selected DP sales and engineering personnel from the GEM Region, outlining existing technical requirements that must be satisfied to be responsive in this market. A tentative date for this seminar is the third week in May.

Item 6: Unconfirmed data input from the OCALA project at KSC indicates that Martin is planning to release the initial technical guidelines document or RFP early in May of 1966. Plans are now being made by this group to define the nature of the IBM response, the personnel who will be involved and the content of the resultant document from IBM. It should be noted that the issuance of an RFP either from Martin or Douglas would be a clear indication that the existing TMCC concept would probably be shelved for at least a 12- to 18-month period (if not longer).

Item 7: The current unified checkout hardware specification document, generated by this group, is in the process of review at IBM Bethesda with a view to incorporating the requirements discussed in that document into the general ROS special hardware concept now being developed at SSC. It is expected that a meeting will be set up in the next two weeks, either at Washington or Los Angeles, to go over in some detail comments received from Martin Corporation, as well as Air Force TMCC personnel, who are presently reviewing the same document.

F. X. O'Rourke

FXO'R:jh

cc: C. B. Brown
W. B. Gibson
W. Gourlay, Jr.

L.A. Westchester GEM-230
April 22, 1966

IBM CONFIDENTIAL

Memo to:
H. G. Hoyt, LSG
P. A. DePascale, LSG
R. K. Rea, LSG
R. P. Bruns, GEM Region
J. W. Richardson, GEM Region
W. B. Gibson, MOL
F. E. Mutz, FSD

Subject: Consolidated Telemetry Checkout Station (CTCS) at Vandenberg AFB

Specifications for the upcoming CTCS RFP are being changed by AFWTR's Telemetry Group. Specifications are now calling for four telemetry processors, with each processor handling a single PCM link and PAM/PDM link. Memory cycle time is now .175 usec with considerable probability that this will be relaxed to 2.0 usec. Software specifications are being rewritten by local SDC personnel with expectation that the specifications will call for a system similar to the approach taken at the SCF for the telemetry processing.

Expected date for release of the RFP is now May 15, 1966. Amended specifications are expected to be in AFWTR procurement channels by April 25, 1966. Fiscal year '66 money is budgeted for this procurement, and so considerable pressure is being put on the Range to award this contract by June 30. In this regard, the summary of tasks and their estimated completion dates outlined in my memo of April 12 should be held firm so as to assure maximum effort during the pre-RFP period.

On a recent trip to FSD's Engineering Lab by F. Mutz and me verbal commitments by J. Nordlie, C. Hesner, and J. Deveer were obtained on the AMCS front end equipment in regard to technical capability, cost to the customer, and delivery. The functions to be performed by the AMCS for both the SGLS and Minuteman telemetry formats are as follows:

1. Serial to parallel conversion
2. Frame sync
3. Subframe sync
4. Code inversion
5. LSB, MSB inversion
6. Data compression
7. Limit checking
8. Standard time input
9. Data identification
10. Communication with either an 1800 or Model 44

Estimated purchase price to the customer is approximately $200,000 for four machines with delivery in the first quarter of 1967. Firm commitments from the Engineering Lab one week after receipt of RFP will have to be obtained in order to consider AMCS for this proposal.

AFWTR personnel have been briefed on the AMCS with considerable interest obtained from the customer. It is becoming obvious that the AMCS is going to be one of the most important elements in winning CTCS. It is extremely important that Pete Davies, FSD Engineering Lab, visit Vandenberg for presentations to both AFWTR and the 6595th Aerospace Test Wing. Pete Davies is the designer of AMCS, as well as the Model 44, and has an extremely good presentation on the AMCS. To this date we have had considerable difficulty in obtaining him for this purpose.

Proposal strategy at this time is to bid four 1800's as the primary proposal, and a single Model 44 as an alternate approach. This decision is based on discussions with AFWTR personnel, who have indicated that a single processor approach does not meet the design approach now considered mandatory by the Range, but they would be extremely interested in seeing this as an alternate proposal by us and would give it serious consideration.

A meeting was held in Washington on April 15 with the following GEM personnel for the purpose of briefing them on the upcoming RFP:

J. Richardson	AF Program
R. Bruns	AF Program
W. Mather	AF Program
J. Harrington	Product Services
D. Heim	Product Marketing
J. Kossuth	Systems Assurance
P. Pistole	Commercial Analysis
R. Bourne	Special Equipment

It was pointed out that due to the short response time needed by the Range on this proposal, normal delays in processing RPQ's, systems assurance, etc., will have to be kept to a minimum. It was also pointed out that our primary competition will come from CDC with their 1700's and that the 1800 is not competitive in either performance or price. It was learned that there were plans for a 1 usec memory for the 1800, but that they had been dropped due to the "technical unfeasibility" of this feature. Approval of this feature is deemed extremely important for not only this proposal, but also to fill a gap in our product line for the high speed data acquisition area. Delivery requirements were discussed and there was general agreement for delivery of either four 1800's or a single 44 in the 1st quarter 1967 time period.

J. H. Priday

JHP/mb
cc: J. Warstler, LSG

WTR Build-up Under Way For MOL, Titan III-C in '68

by Willard Wilks

VANDENBERG AFB, CALIF.—New Air Force launch facility construction beginning this year at Western Test Range (WTR) presages a major strengthening of the U.S. military space posture two years from now.

By mid-1968, according to present schedules, initial launch capability for *MOL* will exist at WTR, where all manned military flights will occur because of the polar orbit requirement (M/R, April 18, p. 14).

Site preparation is now under way on the newly acquired Sudden Ranch property adjacent to Vandenberg AFB. Actual construction of the $18-million ILC (Initial Launch Capability) installation will begin soon.

Capability expansion—Completion of the ILC will mean new capability and growth potential for other important military programs, while providing for manned *MOL* missions. In addition to the seven-segment *Titan III* configuration for *MOL*, the ILC will accommodate any other version of the *Titan III* family utilizing the 120-in. solid strap-ons.

Polar-orbiting programs will be able to take advantage of the 25,000 to 30,000-lb. spacecraft potential provided by the *Titan III-C* family.

"This means that any of the known and classified programs we have been launching out of WTR will be able to utilize the new generation of big boosters and the spacecraft and payload growth that they permit," an Air Force spokesman reported. These programs include communication, nuclear test detection and reconnaissance satellites.

The ILC will consist of one pad where the vehicle will be built up on the pad. Although the facility's launch tower will accommodate only the 120-in. strap-on *Titan III* models, including the full seven-segment configuration, the Air Force is "hedging its bet in the brick and mortar phase of design and construction to permit expansion to accommodate the 156-in. strap-ons if it decides to upgrade the booster in the future," a spokesman said.

"Long-range planning documents and drawings are also such that the ILC could at some future date be expanded into a complete ITL (integrate-transfer-launch) complex, as at Cape Kennedy, with multiple pads."

At present, Air Force plans call for at least five manned *MOL* launches from WTR.

Atlas-Agena launch pad—No other launch construction is needed in the immediate future at WTR, the Air Force reports. In addition to the beginning on the ILC installation, the one other recent improvement has been conversion of one of the *Atlas-Agena* pads for *Titan III-B* (a *Titan III* core with an *Agena* upper stage). The booster will initially be used with the *Agena-D* but is also designed to handle the Transtage, *Centaur* and possible new vehicles.

No other *Atlas* pad conversions are planned at this time. Spokesmen report that the existing eight *Atlas* pads are sufficient for future *SLV-3* launches. "With the new facilities, *Atlas* will be on the way out for Air Force programs," sources said. "*Titan III-C* will become the new workhorse."

The five *Thor* pads at WTR also are sufficient and no new construction needed for the long-tank *Thor*.

On the subject of *MOL* or other recovery plans or facilities, Air Force is making no official comments. It is almost certain, however, that water recovery will prevail in the foreseeable future.

WTR now has no responsibility for recovery. The organization formerly responsible for WTR space-payload recoveries, the 6594th Aerospace Test Wing, Sunnyvale, Calif., has been deactivated. All tracking stations and other facilities of the wing are now part of the world-wide Air Force Satellite Control Facility, headquartered at Air Force Systems Command Space Systems Div., El Segundo, Calif. ■

CUSTOMER NAME:	Air Force Eastern Test Range Patrick Air Force Base, Florida Phone: (IBM) 305/784-9600
REGION:	GEM
DISTRICT:	57
BRANCH:	Cape Kennedy GEM
BRANCH MANAGER:	W. O. Robeson
DP SALESMEN:	A. H. Herrington M. V. Carter J. G. Robertson, Jr.
SYSTEMS ENGINEERS:	Hal Bellamy Gail Lundberg
OTHER IBM PERSONNEL:	R. E. Blue

Eastern Test Range
Patrick AFB, Florida
Brig. Gen. Huston

Engineering
Col. Bertowski

Operations

Biography of MAJOR GENERAL VINCENT G. HUSTON

General Vincent G. Huston was born on 23 May 1914 in Norriston, Pennsylvania. He attended Drexel Institute of Technology, Philadelphia, Pennsylvania, majoring in Electrical Engineering.

General Houston enlisted in the National Guard in January 1938, received his second lieutenant commission in February 1938, and entered pilot training in March 1938 at Air Force Flying School, Kelly Field, Texas. He also attended Maintenance Engineering School, Chanute Field, Illinois, in 1939.

Until 1943, he was given radar and electronics assignments at Wright Field, Ohio. From 1943 to 1945, he served in the Asiatic Pacific and was active in the following campaigns: Northern Solomons; Bismark-Archipelago; and Eastern Mandates.

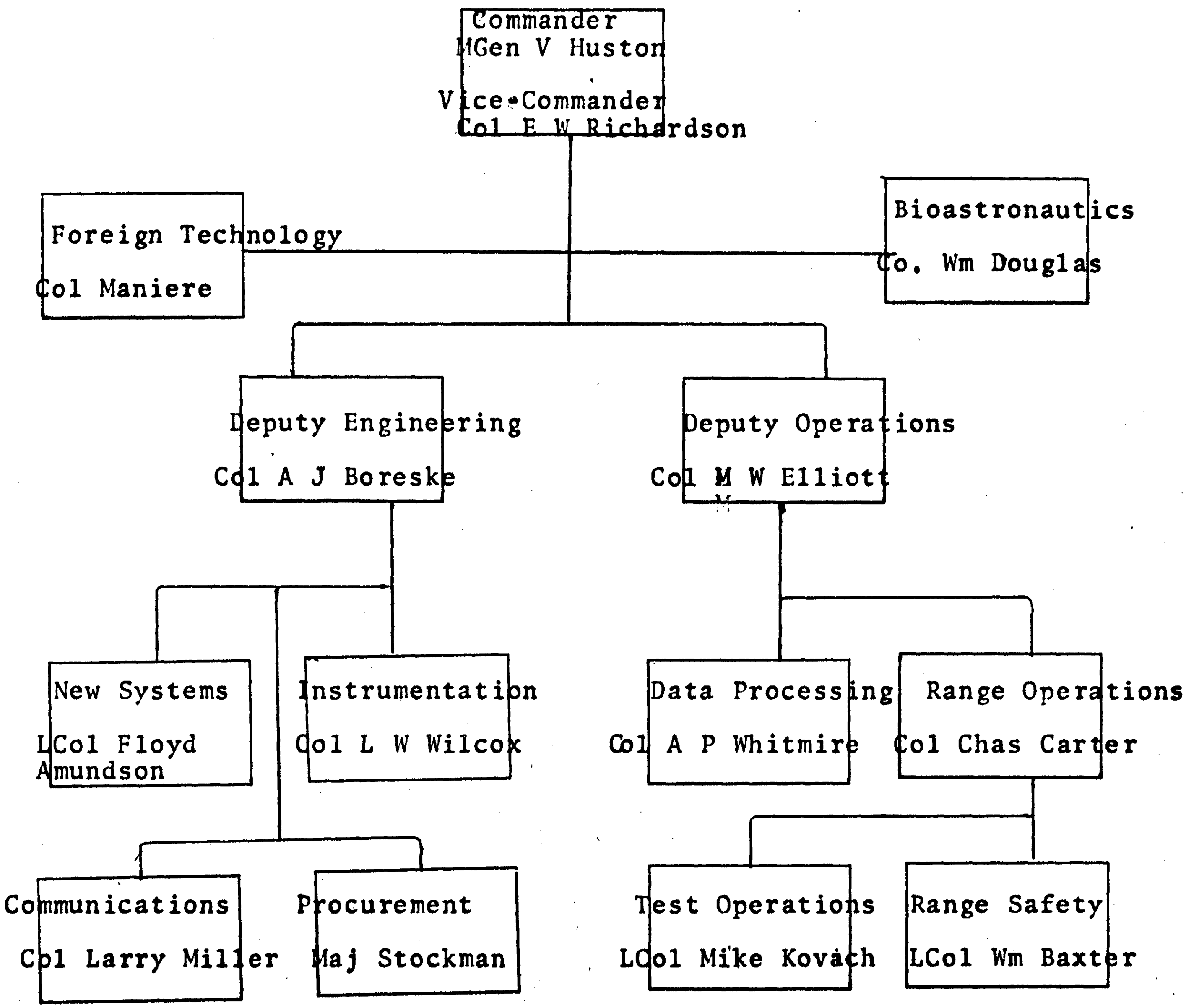
General Huston's assignments after returning to the States included a tour at Wright Field, Ohio, in Directorate of Procurement and Production, Headquarters, Air Materiel Command. In July 1947, he was named Assistant Chief, Inspection Section, Wright Field, Ohio. He was transferred to Aeronautical Equipment Section as Chief in Jan. 1948.

General Huston took the Joint Operations Fourth Class at Armed Forces Staff College, Norfolk, Virginia from August 1948 to December 1948 and was then assigned as Chief of Maintenance, Directorate of Materiel, Headquarters, Strategic Air Command, Offutt AFB, Nebraska. In September 1952, he was assigned as Air Force Member, Military Application Division, Atomic Energy Commission, Washington, D.C., and became Deputy Director, Military Application Division in Sept., 1953. In September 1955, he became Deputy Director, Directorate of Nuclear Systems, Headquarters, Air Research and Development Command.

General Huston was assigned as Commander, 3079th Aviation Depot Wing, Wright-Patterson AFB, with additional duty as Assistant for Special Weapons, Headquarters, AMC on 16 May 1957. In Feb. 1958, he attended the Advanced Management Program, Harvard University, for three months and then returned to his previous assignment.

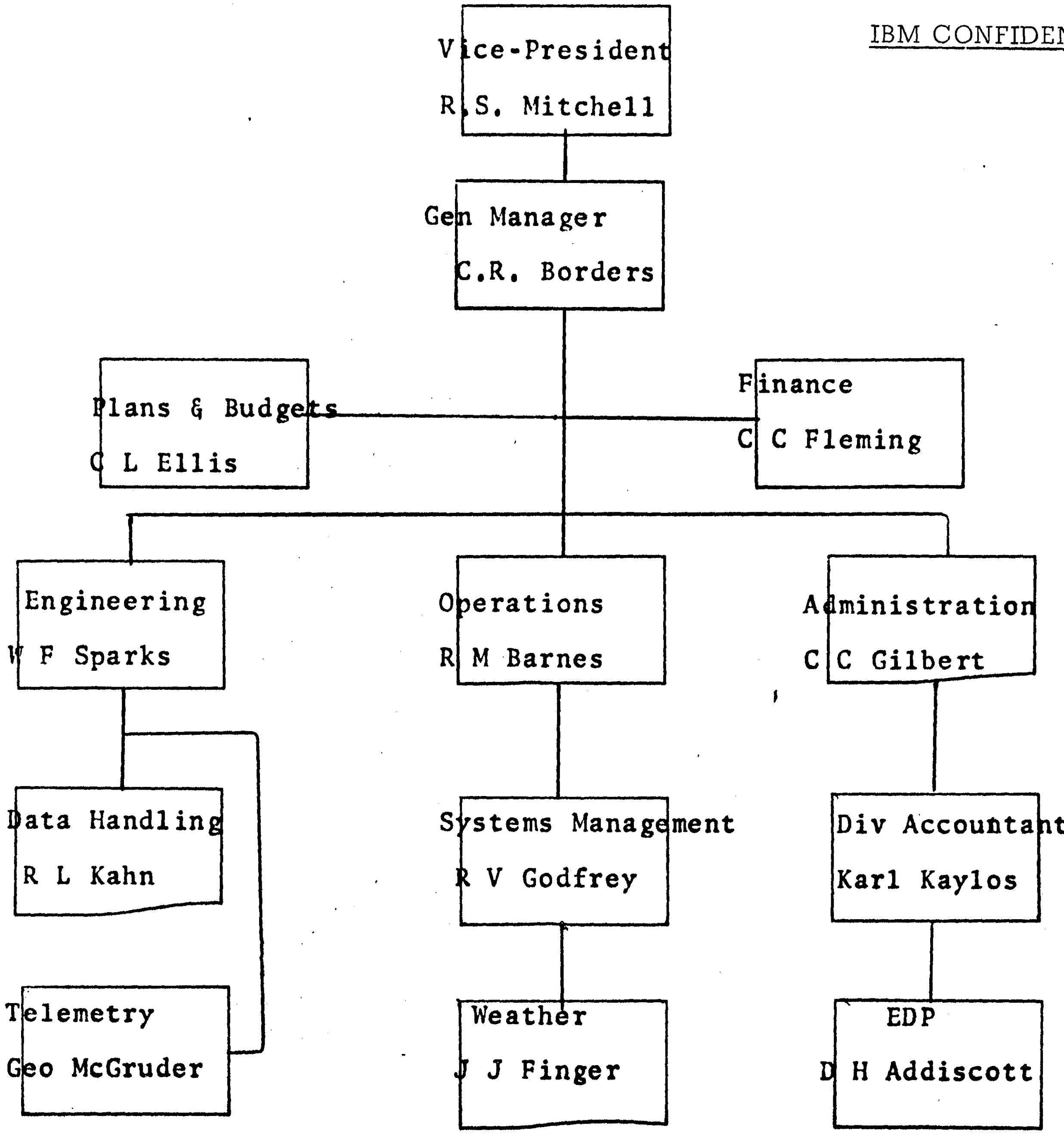
In July 1960, he was assigned as Commander of Air Materiel Forces, Pacific Area, at Tachikawa, Japan. In June 1962, General Huston was assigned to Headquarters, Pacific Air Forces, Hickam AFB, Hawaii, as Assistant Chief of Staff, Materiel. He was then assigned as Commander, Air Force Eastern Test Range in July 1964. On 19 July 1964, he was promoted to the rank of Major General. General and Mrs. Huston have a daughter, Patricia Frances. He is rated a command pilot.

Air Force Eastern Test Range



Pan American World Airways - GMRD

IBM CONFIDENTIAL



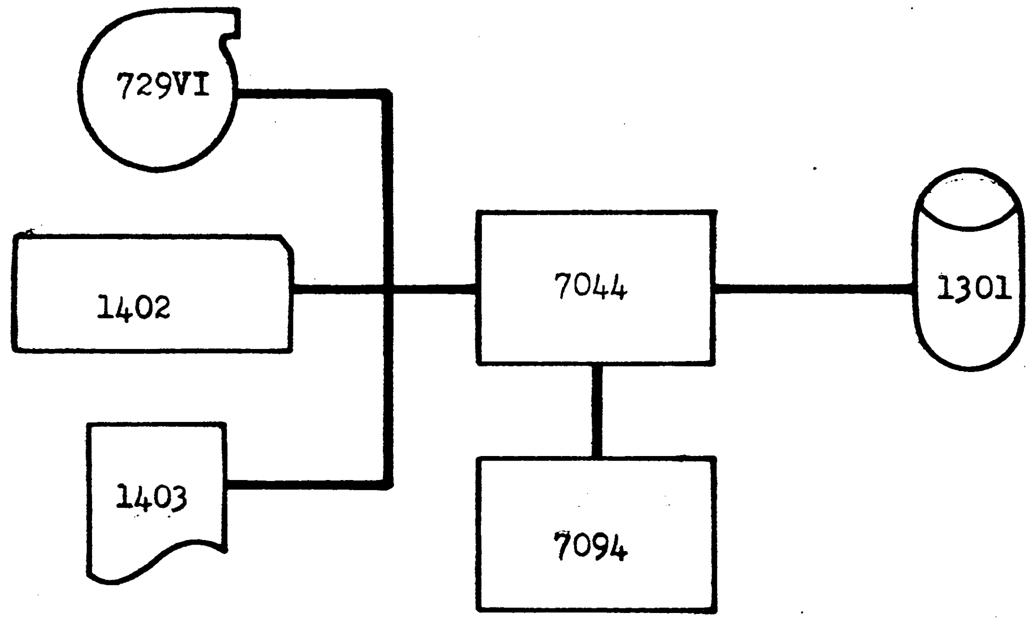
B.1 ETR will support MOL much the same as any other major program. The impact is predicted to be about twice that of the Gemini program. SSD will become a very large and important Range User, in fact, second to NASA.

ETR's role is gradually shifting from that of Launch Support to On-Orbit Support. Other major on-orbit range users are OAR, NORAD and Foreign Technology. Support of the MOL Program at ETR will be similar to support of the OV series sponsored by OAR, except that the amount of data handled will be vastly greater. On-orbit support computers are projected for Antigua and Ascention Islands FY69.

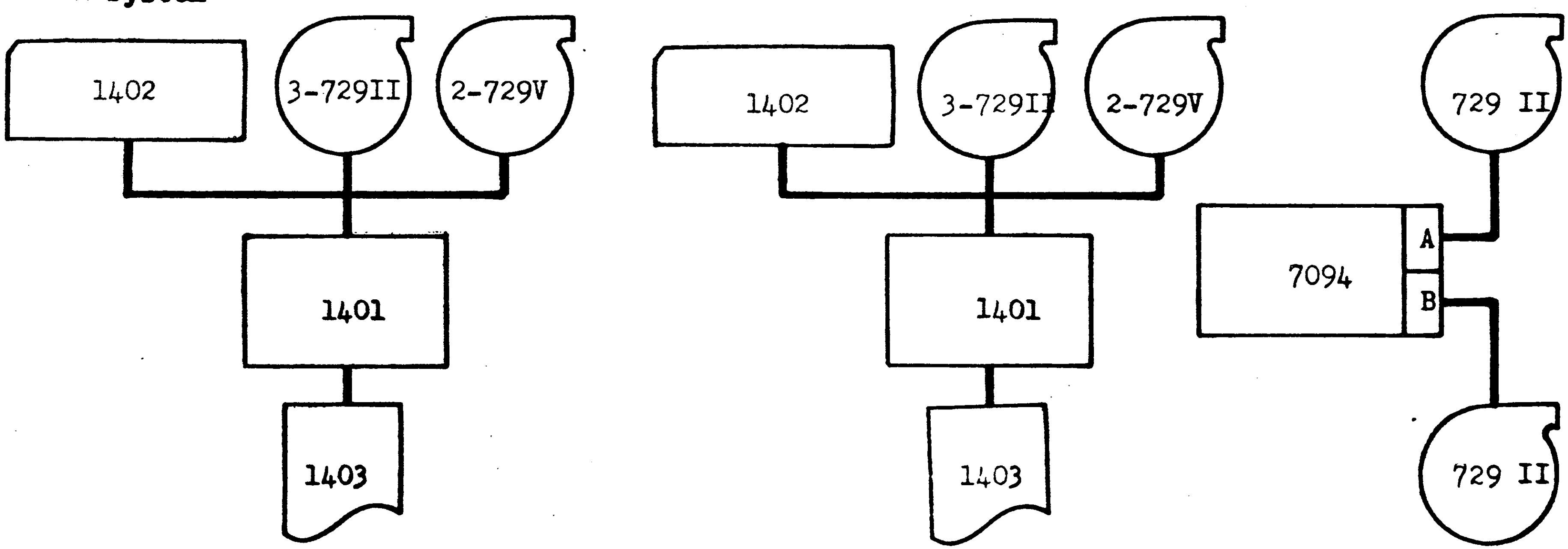
DATA REDUCTION

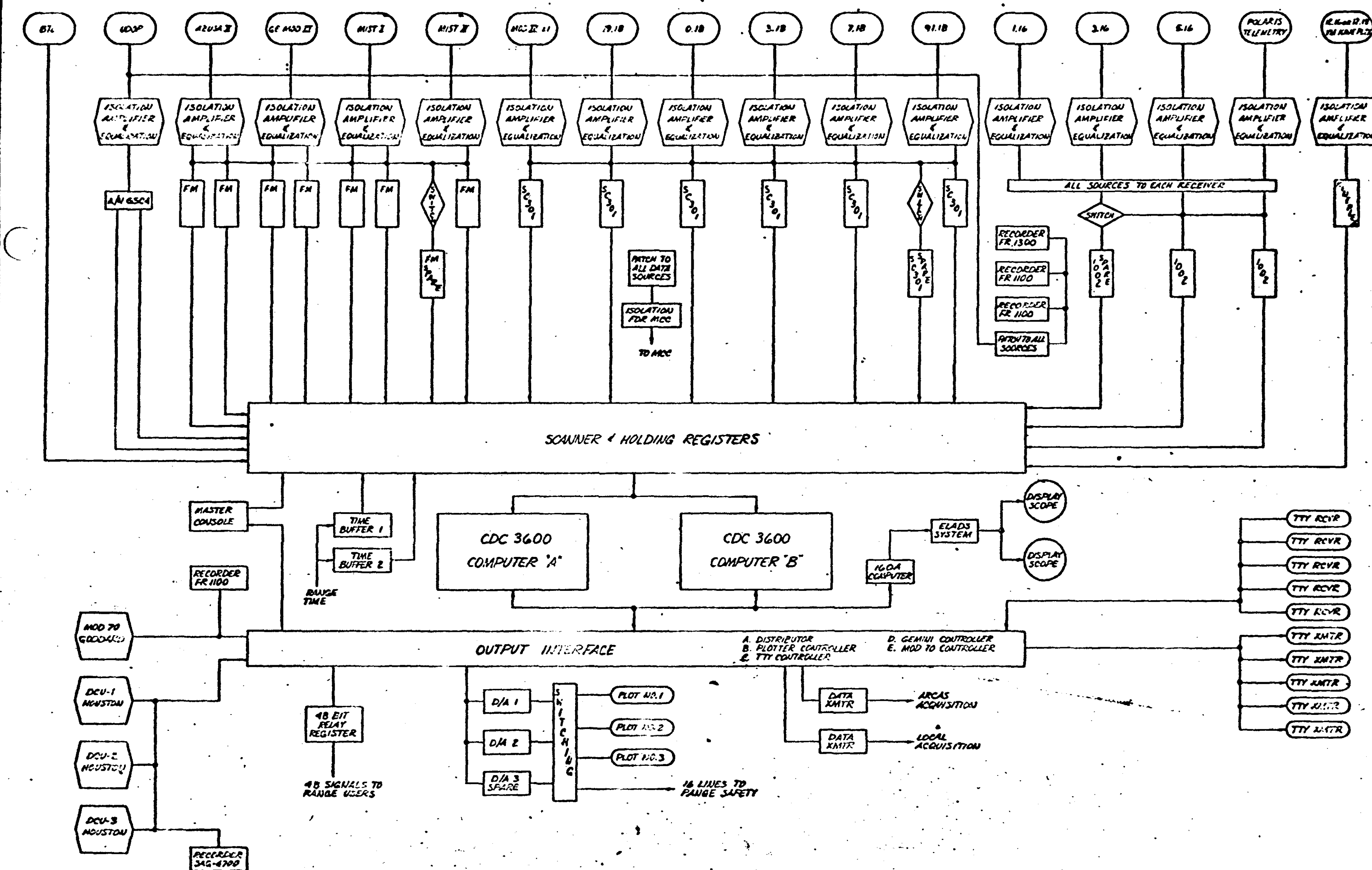
COMPUTER EQUIPMENT

POD System



BATCH System





ETR - REAL TIME COMPUTER SYSTEM

IBM CONFIDENTIAL

C.1 CURRENT STATUS

There are no outstanding proposals that affect the MOL program.

A proposal is outstanding to replace a 1410 and 1460 with 360's, Mods. 30 and 40, at Pan American EDP.

An order has just been received to replace two 1401's with a 360, Mod. 40 at USAF Technical Laboratory for data reduction. A second Mod. 40 is anticipated by March 1966.

D. PROBLEM AREAS

The major local problem involves the Real Time Computer Facility with competitive equipment of two 3600's and one 3100. The 3600's have been accepted less than one year, and there is minimum Air Force interest in planning for their replacement at this time. IBM has the dual problem of preventing CDC expansion of this center and influencing a decision for total replacement. The Air Force is not now receptive to an unsolicited proposal. We need as much advanced information as possible on new requirements that may help overcome this barrier.

E. IBM STRATEGY

E.1 Sales Action Program

Local coverage is maintained for the following:

a. NRD Detachment #1 (technical group of 180 people).
b. Air Force Eastern Test Range and Patrick Air Force Base.
c. Pan American World Airways, Inc., Guided Missiles Range Division (prime contractor).
d. RCA Service Company-Missile Test Project (sub-contractor for operations and maintenance).
e. Aerospace Corporation - Eastern Division.

Most action centers around two major accounts:

a. Air Force Techinical Laboratory: This is a separate data reduction facility. Workload is from World-wide sources, including Pacific Advanced Range Instrumentation Ships. Expansion to time-sharing for local technical users is planned here.

b. Cape Kennedy Air Force Station: This is the location of the RTCF used for impact prediction and acquisition messages of all types. It is the area of concern with MOL requirements.

E.2 Technical Help Required

It is anticipated that techincal help will be needed for hardware interface engineering to existing equipment. This is a major effort that should not await an RFP.

E.3 IBM System Design

This is incomplete at the present time. Under investigation is the Mod. 67 and 9020.

F. SCHEDULE OF KEY TARGET DATES

1. RFP for Weather real-time and data reduction system - 17 January 1966 - Date of contract 1 May 1966.

2. Cape Orbit-Support Computer and SCF interface, FY 67.

G. COMPETITION

G.1 Competition is virtually limited to CDC on the mainland and Univac downrange and on ships.

CDC is most active with three local salesmen and approximately four local systems engineers. They are noted for giving little attention to the problem, talking about the 6000 series as the answer to all problems, and bidding minimum systems with the hope of building up. Their strength with Pan American has been partly lost by attrition and poor performance in the area of 3600 reliability. They appear to be concentrating on NRD at the present time.

Univac is represented by two salesmen locally and is a virtual sole source for Mil Spec downrange and shipboard equipment.

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IBM

Date: January 21, 1966
(Dept/Loc): Cape Kennedy 105
Telephone Ext.:

Subject: Comments on MOL Project Notebook

Reference:

To: Mr. W. B. Gibson
MOL Program Director
Los Angeles Aerospace

In the latest entry to the Notebook, your letter to Mr. C. E. McKittrick, Jr. dated January 6, 1966, a reference is made to "our relatively weak current position at the Cape." We agree that the present Cape effort involves fewer people, but we believe the IBM strength position at the Cape has been underestimated. In fact, we would rate the chance of IBM winning any MOL connected RFP as good or better at the Cape than at West Coast locations. From your letter we are apprehensive that the many recipients may get an erroneous impression from the Cape reference.

We are sure that our minimum inputs to date have not expressed the Cape position very well. We will try to improve this communication. We believe the MOL Project Notebook to be an excellent working tool and are already using it to good advantage.

I am enclosing a copy of NRD Regulation No. 25-2 of December 14, 1965 on the subject of range computer operations management. I am not sure that this regulation should be included in the Project Notebook, but is passed along for your information because it shows the present intent of NRD and the importance of coverage of the Technical Detachment at PAFB.

A. H. Herrington
A. H. Herrington
Advisory Marketing Representative

AHH/dlh

Enclosure

cc: Mr. R. P. Bruns
AF Program
Gem Region

NRD REGULATION
NO. 25-2

HEADQUARTERS NATIONAL RANGE DIVISION
Patrick Air Force Base, Florida
14 December 1965

Management Engineering

COMPUTER OPERATIONS MANAGEMENT

PURPOSE: This regulation establishes NRD policy on operations management of range computer resources, and assigns responsibilities.

1. Scope: This regulation applies to all elements of the National Range Division.

2. Terms Explained. Computer resources--all equipment, funds, and labor used to perform the range computing function.

3. Exclusion. This regulation does not apply to computers procured for business accounting and administration under the provisions of AFM 171-9.

4. Policy. NRD agencies will procure and operate range computers under waivers to AFR 300-series regulations and AFM 171-9. Ranges must:

a. Assure effective use of each computer.

b. Conserve computer resources.

c. Configure all mission computers and computing systems to permit rapid cross-servicing between ranges and, when applicable, to operate in a worldwide network.

5. Responsibilities:

a. Headquarters NRD will:

(1) Monitor computer operations and use of computer resources, and coordinate between ranges.

(2) Resolve inter-range operational problems and user priority conflicts.

(3) Establish inter-range standards for computer selection, operation and use, and for software generation, documentation and control.

(4) Establish and publish NRD inter-range computer operations policies and procedures.

b. NRD Ranges will:

(1) Reduce computer operating overhead by consolidating similar tasks and overhead activities, such as computer programming and maintenance.

(2) Limit the amount of test data reduced by establishing formal procedures for determining users' needs before each test.

(3) Configure the real-time computer systems at both ranges to use common hardware and software; support inter-range operations; and perform all real-time or near real-time computing tasks at the range head.

(4) Configure the data reduction centers at both ranges to use common hardware and software; permit rapid cross-servicing between ranges; and perform all data reduction, analysis, and scientific computational tasks.

(5) Conduct a semiannual Computer Program Survey and retire programs which are no longer needed.

(6) Conduct an annual Computer Operations Review.

6. Reports:

a. Ranges will submit a semiannual Computer Program Survey Report to Headquarters NRD (NROE) by 15 February and 15 August each year. It will include:

OPR: NROE
DISTRIBUTION: S

IBM CONFIDENTIAL

Date: December 1, 1965
From (Dept/Loc): 104
Phone Ext.:

IBM

Subject: Titan III-C Program at ETR

Reference:

To: W. B. Gibson

I understand that the Martin Company has been given a contract for 17 additional Titan III-C standard launch vehicles. These will be boosters for payloads which as yet have not been specified. The current R and D program for the Titan III-C is also for 17 boosters with all of the remaining ones having an active payload. Vehicles 11 and 12 will carry Philco payloads and 13 will have a Philco and G. E. payload combined.

This extension of the ITL facility utilization is considered by some Martin Company Cape people as justification for up-grading their GSE for improved launch control and to offer a service for payload checkout. The results of the OCALA Study Project will have a strong bearing on their ability to sell this concept.

I believe that the Air Force will be so dependent on the OCALA system by next June that they will continue it as an operational system until a replacement system can be procured. IBM must be ready to propose a replacement system around April, 1966. It will probably have to be installed in late 1966 to avoid a competitive procurement. The ETR and WTR systems need not be alike, in my opinion, but it would be desirable if they could be. I believe this will depend on the extent to which the WTR system replaces the present GSE used on the Titan III.

Your assistance on getting an early delivery schedule would be appreciated.

REB/cfc

R. E. Blue

cc: W. O. Robeson
R. W. Swanson

No Major Expansion Seen Necessary for ETR Launches

by Kurt Voss

PATRICK AFB, FLA.—The Eastern Test Range will probably not undergo any major changes in its launch facilities in the foreseeable future.

Col. O. C. Ledford, commander of the 6555th Aerospace Test Wing, which has jurisdiction over Air Force launch activities at ETR, says: "We have the core of the facilities we require here for military space work. The *Titan III* is the vehicle to provide military space developmental capability."

He sees the *Titan III* as "the DC-3 of the military space program," and predicts that all developments in the immediate future will be based on adaptations of the liquid/solid vehicle.

The only major facilities modifications he sees would be those required by use of a seven-segment *Titan III* booster configuration, instead of the five-segment solid strap-ons now used. The switch to the longer booster would require modifications of the launch pad flame bucket, the *Titan* transporter undercarriage, and heavy cranes in the solid-motor assembly building.

Expanded ITL not seen—Though the *Titan III* integrate-transfer-launch complex (ITL) at Cape Kennedy could probably be expanded to handle the seven-segment version of the booster, the Air Force thus far has not identified any missions to be flown from ETR which would require this.

High-ranking Air Force officers also admit that the ITL at the Cape would not be readily expandible to handle the 156-in. solid motor strap-on if a mission develops for that vehicle.

The Air Force is preparing a follow-on production plan for additional five-segment *Titan III-C* vehicles (M/R, April 18, p. 14), in addition to the 10 remaining R&D vehicles. The new vehicles will be used to launch replenishment payloads from ETR for the Initial Defense Communications Satellite Program (IDCSP), for nuclear detection satellites and probably for some new multiple engineering payloads from ETR. In addition, the *Titan III-C* will probably be required for lofting communications satellites associated with both follow-on strategic and tactical comsat systems (M/R, Jan. 31, p. 46).

Launch officers here also foresee no changes in command and control facilities outside of the switch in telemetry and command radio frequencies now going into effect. "We have a capability here now that far exceeds our present work load," they have reported.

New recovery concept—At nearby Orlando AFB, the Air Force's Aerospace Rescue and Recovery Service (ARRS) has come up with a new helicopter/in-flight refueling team concept for water recovery which could go a long way toward taking some of the strain off the Navy's recovery fleet.

The operation is especially appealing as planning for the *Manned Orbiting Laboratory* program gets under way.

With *MOL* crews orbiting for 30-day missions, the requirement to be prepared for sudden mission aborts could tie up a substantial number of Navy ships on an almost permanent basis. This is a real and troublesome problem at this point.

Using the new helicopter/fixed wing refueling aircraft team, ARRS officers point out that recovery squadrons posted at key spots around the world would allow *MOL/Gemini-B* spacecraft to be picked up by crews which were continually on alert but which did not have to be on station.

"For the first time," says Col. Bestow R. Rudolph, deputy chief of plans at ARRS headquarters, "we will have a true rescue capability as of the end of this year, even with no support ships in a given area."

At present, ARRS has 30 four-engine C-130's and 10 Sikorsky HH3E helicopters available for its worldwide rescue work. It has been authorized a total of 54, plus backups, in its stock of C-130's, and a total of 24 of the 140-knot helicopter.

Aircraft-helicopter team—Using the team concept, the C-130's double as rescue aircraft, which carry and drop pararescue teams, and as flying tankers, which carry large loads of fuel for the HH3E helicopters.

The newly developed system of in-flight refueling gives the HH3E's an almost unlimited range, and their speed is enough to shift areas of coverage quickly to follow changing orbits.

Should a landing footprint change, the refuelable capability will allow the helicopters to change position immediately without the need to return to land or a ship, either of which could be hours away.

Even larger helicopters—the Sikorsky HH53A—have been ordered. These craft are large enough to pick up the entire *Apollo* space ship from the water and carry it long distances, with the crew still inside, if necessary.

Col. Rudolph predicts that in the near future these larger helicopters will be the prime recovery vehicles, with the Navy doing the support of a pickup mission—just the opposite of today's recovery modes.

Delivery of the new units will start in August when two CH53A's, cargo helicopters converted to search and rescue equipment, will arrive at Patrick. Rescue capabilities with the new craft will start small and grow as equipment funding becomes available.

The HH53A's will be equipped to use the team concept, with refueling capabilities even when carrying full loads.

Emergency rescue—Another new concept, just publicly demonstrated, also is in ARRS plans for emergency recovery use. The first week in May marked the public testing of the Fulton pickup system, by means of which a downed astronaut can be snatched from water or dry land by a C-130, or similar plane, even if weather keeps helicopters away.

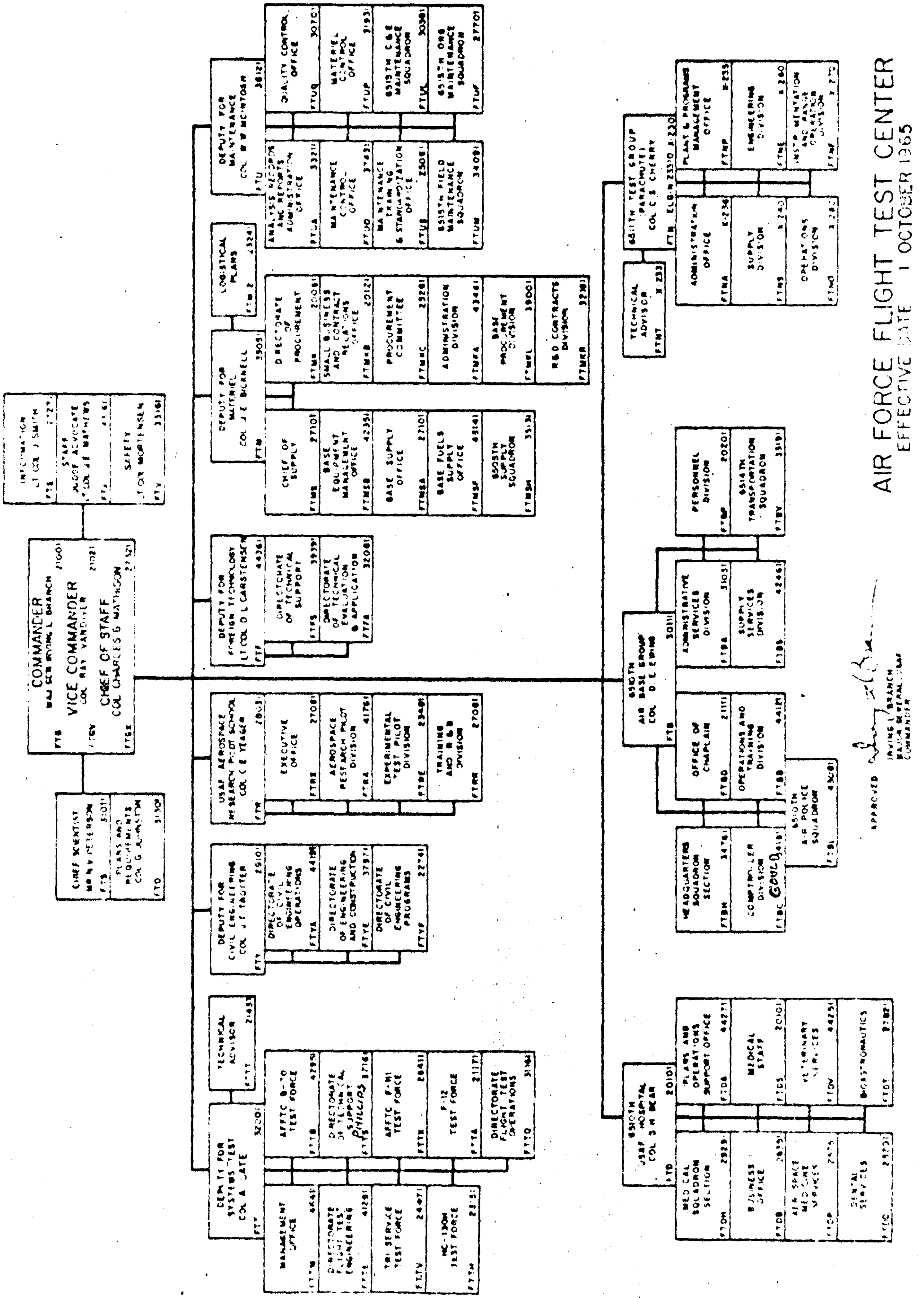
Using the system, the downed flyer dons a special suit-like harness. He inflates a polyethlene balloon with helium gas. This balloon lifts a 500-ft. nylon line into the air, one end tied to the harness and the other held aloft for pickup by the plane.

As the aircraft approaches, its pilot lines up a V-shaped guide on the plane's nose with the line and flies into it. As the line strikes, a small arm in the apex of the V suddenly twists, locking the line securely The cable is pulled back by the airstream against the plane's underside, where it is grabbed at the rear of the fuselage and hooked onto a winch.

G-forces on the man being picked up are said to be less than those experienced in a normal parachute jump and much less than those of previous pickup systems.

The entire pickup kit—harness, balloons, gas supply, and nylon line—is dropped by the pickup plane. □

CUSTOMER NAME:	Air Force Flight Test Center Edwards Air Force Base California Phone: CLifford 8-2111
REGION:	GEM
DISTRICT:	Western
BRANCH:	Riverside
BRANCH MANAGER:	J. F. Bales
DP SALESMEN:	Bob Glascock Dale Edwards
SYSTEMS ENGINEERS:	Jim Brown Jim Clarke Ted DeSimio Bob Hill
FSD REPRESENTATIVES:	Bob Strayer Paul Lindfors


AIR FORCE FLIGHT TEST CENTER
EFFECTIVE DATE 1 OCTOBER 1965
COMMANDER
VICE COMMANDER
CHIEF OF STAFF
CHIEF SCIENTIST
PLANS AND REQUIREMENTS
INFORMATION
STAFF JUDGE ADVOCATE
SAFETY
DEPUTY FOR SYSTEMS TEST
TECHNICAL ADVISOR
MANAGEMENT OFFICE
DIRECTORATE FLIGHT TEST ENGINEERING
TRI SERVICE TEST FORCE
NC-130H TEST FORCE
AFFTC B-70 TEST FORCE
DIRECTORATE OF TECHNICAL SUPPORT
AFFTC F-111 TEST FORCE
F-12 TEST FORCE
DIRECTORATE FLIGHT TEST OPERATIONS
DEPUTY FOR CIVIL ENGINEERING
DIRECTORATE OF CIVIL ENGINEERING OPERATIONS
DIRECTORATE OF ENGINEERING AND CONSTRUCTION
DIRECTORATE OF CIVIL ENGINEERING PROGRAMS
USAF AEROSPACE RESEARCH PILOT SCHOOL
EXECUTIVE OFFICE
AEROSPACE RESEARCH PILOT DIVISION
EXPERIMENTAL TEST PILOT DIVISION
TRAINING AND R & D DIVISION
DEPUTY FOR FOREIGN TECHNOLOGY
DIRECTORATE OF TECHNICAL SUPPORT
DIRECTORATE OF TECHNICAL EVALUATION & APPLICATION
DEPUTY FOR MATERIEL
LOGISTICAL PLANS
CHIEF OF SUPPLY
BASE EQUIPMENT MANAGEMENT OFFICE
BASE SUPPLY OFFICE
BASE FUELS SUPPLY OFFICE
6505TH SUPPLY SQUADRON
DIRECTORATE OF PROCUREMENT
SMALL BUSINESS AND CONTRACT RELATIONS OFFICE
PROCUREMENT COMMITTEE
ADMINISTRATION DIVISION
BASE PROCUREMENT DIVISION
R&D CONTRACTS DIVISION
DEPUTY FOR MAINTENANCE
ANALYSIS RECORDS AND REPORTS ADMINISTRATION OFFICE
MAINTENANCE CONTROL OFFICE
MAINTENANCE TRAINING & STANDARDIZATION OFFICE
6515TH FIELD MAINTENANCE SQUADRON
QUALITY CONTROL OFFICE
MATERIEL CONTROL OFFICE
6515TH C&E MAINTENANCE SQUADRON
6515TH ORG MAINTENANCE SQUADRON
6510TH AIR BASE GROUP
OFFICE OF CHAPLAIN
OPERATIONS AND TRAINING DIVISION
6510TH AIR POLICE SQUADRON
HEADQUARTERS SQUADRON SECTION
COMPTROLLER DIVISION
ADMINISTRATIVE SERVICES DIVISION
SUPPLY SERVICES DIVISION
PERSONNEL DIVISION
6514TH TRANSPORTATION SQUADRON
6511TH TEST GROUP (PARACHUTE)
TECHNICAL ADVISOR
ADMINISTRATION OFFICE
SUPPLY DIVISION
OPERATIONS DIVISION
PLANS & PROGRAMS MANAGEMENT OFFICE
ENGINEERING DIVISION
INSTRUMENTATION AND RANGE OPERATIONS DIVISION
6510TH USAF HOSPITAL
MEDICAL SQUADRON SECTION
BUSINESS OFFICE
AEROSPACE MEDICINE SERVICES
DENTAL SERVICES
PLANS AND OPERATIONS SUPPORT OFFICE
MEDICAL STAFF
VETERINARY SERVICES
BIOASTRONAUTICS
APPROVED
IRVING L BRANCH
MAJOR GENERAL USAF
COMMANDER

A. 1 PERSONNEL PROFILE

a) Col. Robert Gould - Flight Test Center Comptroller believes strongly in central management of data processing equipment. Frequently "Bumps Heads" with scientific side of house.

b) Mr. Ralph Western - Chief, Data Systems and Statistics Branch. Data Processing Equipment Control Officer for the Flight Test Center. Reviews and exercises approval authority on all Center initiated requests for digital data processing equipment.

c) Mr. Alfred Phillips - Chief, Directorate for Technical Support. Heads entire plethora of ground based technical support for all flight test programs.

d) Mr. Alfred Miller - Chief, Data Systems Division. (Mr. Harold Knausdorf - Acting during one years leave of absence by Miller). Responsible for Acquisition, Reduction, Processing and Analysis of Scientific Type Flight Test Data.

e) Mr. Charles Kroll - Chief, Requirements Analysis Division. Responsible for coordination with all other divisions in the definition of requirements for future flight test projects.

f) Major Harold Smith - Chief, Data Systems Engineering Division. Responsible for all non-standard special purpose data systems connected with flight test projects.

g) Col. Charles Yeager - Commandant, Aerospace Research Pilot School. Responsible for advanced flight training and technical classroom training for all Air Force Astronauts and Experimental Test Pilots.

B. BACKGROUND

B.1 The Air Force Flight Test Center has the mission of performing initial evaluation on all winged, lifting body, and rotary type aircraft that might enter the Air Force inventory. Prior to project cancellation in early 1964, the Flight Test Center was designated as primary recovery site for the X-20 Dynasoar Vehicle. Current role in MOL is restricted to crew training at the Pilot School. Unless land recovered Shuttle Vehicles are to be utilized, Flight Test Center Personnel see no direct mission in support of MOL.

B.2 Equipment installed at FTC includes:

a) 7094/7044 Direct Couple System including a 7288 Real-Time Interface with the Edwards Range.

b) 1410 File oriented system for commercial type data processing.

c) 1620 - 40K System for use by Flight Test Engineers as "Quick-Look" machine.

C. CURRENT STATUS

C. 1 The Flight Test Center is one of the four accounts involved in the recent Air Force Multiple Replacement Program (IBM Name: Project FORCE) along with: Systems Engineering Group (SEG), Wright-Patterson AFB, Ohio; Air Proving Ground Center (APGC) Eglin AFB Florida; and Ballistic Systems Division (BSD), Norton AFB California.

IBM submitted a "Technical Information Document" and a No-Bid due to inability to meet Air Force Demonstration requirements. The Air Force has since decided that no EDP Manufacturer was responsive and present information indicates a repetition of the exercise in second quarter 66.

July 5, 1966

To: Mr. W. B. Gibson
Frank Bales

Subject: Edwards Air Force Base - MOL Participation

Lt. John Prodan, Chief of the simulation Division, Aerospace Research Pilot School, today told me that the Simulators for MOL will be located at Huntington Beach and at Vandenburg. He said that the only mission that Edwards will have, at least at present, will be in the first phase of training.

/s/

Bob Glascock

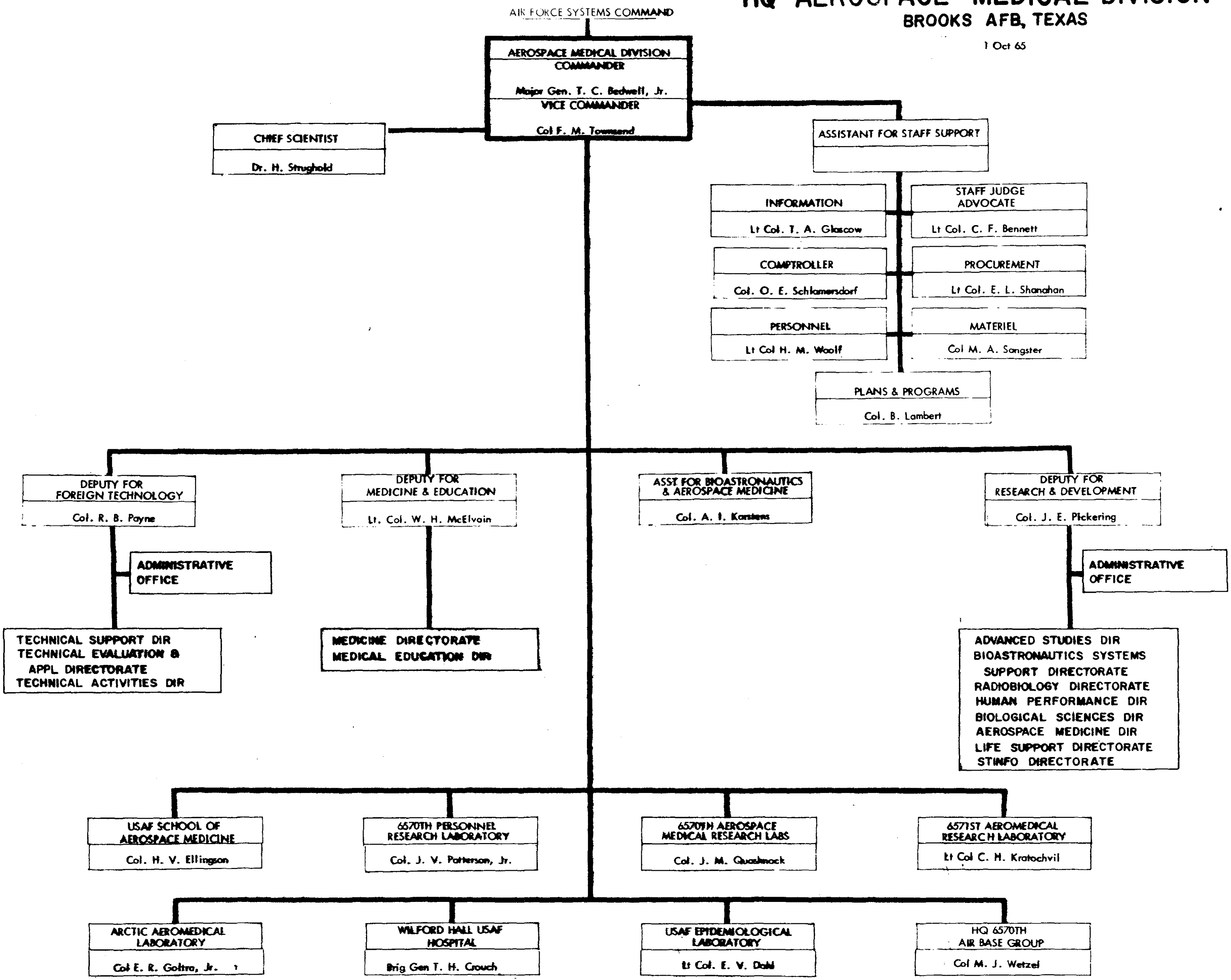
BG:md
cc: Dale Edwards

CUSTOMER NAME:	Aerospace Medical Division Brooks Air Force Base San Antonio, Texas Phone: 512/532-8811
REGION:	Western
DISTRICT:	14
BRANCH:	San Antonio
BRANCH MANAGER:	J. R. McSween
ACCT. MANAGER:	J. R. McSween
DP SALESMAN:	Pat Graham
FSD REPRESENTATIVES:	Bill McLain
OTHER IBM PERSONNEL:	Tom Johnson, Federal Rep.,San Antonio Bob Vesper, CE, San Antonio Charlie Brown, MOL Proj.Office, LA

HQ AEROSPACE MEDICAL DIVISION

BROOKS AFB, TEXAS

1 Oct 65



B.1 Backgrounds

Dr. Danford - Biometrics Branch Chief

Neutral to negative on IBM hardware; likes his Philco 2000.

Has turned down an attempt to present our 360 presentations.

PhD in Statistics -- no modern concepts applications orientation -- L.P., CPM, GPSS, Etc.

Has turned down numerous attempts to enroll in IBM schools.

Very hard nut to crack.

Does like some of IBM's work in med. application area.

Seems open to an approach on communication aspects of MOL, but suggests a contract study (Lockheed).

Dr. Hughs

No data; passes all calls to Dr. Danford.

Mr. Bob Bales - Computer Ops Chief

Good automation man. Would like to work with us, but he is #3 and has no decision authority.

All three men were very heavily involved in medical data reduction on all astronauts up to the present time. They will probably fill the same function on a now real time basis, in the MOL program.

Mr. Adams - Environmental Br.

Interested in development and utilization of medical data sensory devices on board the vehicle, provide data to Dr. Danford via telemetry and a communication capability into SAM.

B.2 IBM has keypunch and unit record installed.

IBM CONFIDENTIAL

IBM

Date: December 27, 1965
From (Dept/Loc): San Antonio 390
Telephone Ext.:

Subject:

Reference:

To: Mr. W. B. Gibson
MOL Project Director
Western Region

I spent approximately an hour with Lt. Colonel Stan White, AMD, Brooks Air Force Base, last Friday morning. Results:

1. He is going to Washington this summer to act as the AMD Coordinator with the Headquarters AFSC MOL Project office. He will be in the same position there as Colonel Carstairs is in, in California.

2. LTC Ord, AMD, will be MOL Project Coordinator at AMD, Brooks Air Force Base.

3. AMD's tasks under the MOL Project will include:

   a. Personnel selection.

   b. On long term-days-manned flights, they will provide a near real-time, bio-medical data reduction capability.

   c. Analysis of occurrences to/or by humans, during and after flights to provide input for decision concerning personnel selection, flight duration, man or machine job/experiment mix.

4. LTC White may attend EX-34 in San Jose, January 31 through February 4, 1966.

Dr. Danford, Biometrics Chief, has turned down invitations to attend SC-78 and EX-34. Feels he knows enough now to evaluate his needs. Present equipment consists of Philco 2000, 4K mainframe, 8 tape drives, A to D to A converter for interface with PACE 3000 Analog Computer, IBM keypunch 407-519.

Pat Graham

Pat Graham
Federal Marketing Representative

PG:al

April 4, 1966

TO: Mr. Charlie Brown
MOL Project Office
9045 Lincoln Boulevard
Los Angeles, California 90045

Here is a write-up on some of the activities at AMD for your interest. Of more immediate importance for our notice is the situation concerning Dr. Danford's Philco 2000. I think a decision has been made to replace it with a whole new package; and, as soon as we and Univac finish our proposals and a selection is made, they will go in for new equipment. I have not been able to dent Dr. Danford, Dr. Hughes, or Mr. Bales at all, but we keep trying. The write-up of the Altac/Tac to FORTRAN II/FAP translators in the December ACM Journal may help us when they bring up the conversion problems again, as they no doubt will. Dr. Danford's feeling has been for a long time that, aside from being very satisfied with their system, they were locked in by their software inventory; and this conversion capability may be a way in for us. I'll keep you posted.

Pat Graham

PG:al

Bends Posing Difficult Problems in Space Science

By JERRY LOCHBAUM

The threat of space bends is posing difficult problems for Air Force scientists seeking ways to protect space-walking crewmen of future orbiting laboratories against this dangerous low-pressure ailment.

Extent of the problem of the bends—caused by the bubbling of dissolved gases when pressure on the body is lowered—is reflected in these new developments at the School of Aerospace Medicine at Brooks AFB:

- A team of researchers has just completed a lengthy series of tests and is preparing to report formally that helium, breathed with oxygen instead of the nitrogen of ordinary air, has failed to provide bends protection some authorities had predicted.
- In the tests, about one man in five got bends in 206 manflights simulating Air Force Manned Orbiting Laboratory (MOL) missions. Bends occurred in simulated space suit work outside the MOL.
- A new series of tests has begun in which men who get bends in lower-pressure space suit conditions are treated in higher-pressure spaceship cabin conditions, to determine time lapse necessary between extra-vehicular activity (EVA) excursions into space.
- The idea is emerging that an orbiting laboratory cabin pressure higher than that in present spaceships would be desirable, to permit a space walker in trouble to use his own ship as an emergency recompression chamber capable, with his space suit, of returning him to ground pressure.
- Frequency of bends after exposure to possible future two-gas spaceship atmospheres causes some to think the SAM studies could lead to making bends-susceptibility a criterion for space crew selection.

BENDS HAVE been a traditional problem of deep-sea divers, who face lower pressures on the body when they come up. The bubbling of the gases in the blood can cause much pain and possibly disable the bends sufferer, and it can be fatal.

The bends problem is not regarded as a serious one for today's space-walking astronauts, who breathe pure oxygen. The nitrogen portion of air is principally blamed for causing bends.

While pure oxygen has been proven safe for use up to 30 days, it can have dangerous effects and space scientists have been looking for a better kind of mixed-gas atmosphere.

Nitrogen-oxygen and helium-oxygen appeared to be the most likely prospects. Helium's promises of offering less risk of the bends, because of its lower solubility in the body, was one principal reason for its selection for thorough evaluation in SAM studies which began in November, 1964.

SAM researchers had begun studies of nitrogen-oxygen bends risks in early 1964. They later expanded their program to compare helium-oxygen effects.

MAJ. SARAH E. BEARD, a key figure in the bends studies, said especially qualified volunteers in space chambers were put through pressure changes which might be met on an MOL mission with EVA, in paired flights carefully controlled so nitrogen vs. helium comparisons would be precise.

Time of bends danger came after leaving simulated MOL conditions—half sea-level pressure in two types of flights and one-third that pressure in another—to go to space suit pressure one-fifth that at sea level.

"Decompression following exposure to helium-oxygen," said Maj. Beard and her co-workers, "generally caused an equal or greater number of cases of bends in varying grades of pain than did exposure to nitrogen-oxygen."

While helium has been found faster than nitrogen both in entering and leaving solution in the body, the researchers said from comparison of effects it "appears that, once precipitated, 'nitrogen bends' and 'helium bends' are similar . . ."

Others on the bends study team were Dr. T. H. Allen, head of SAM's physiology branch, Dr. (Lt. Col.) R. G. McIver, and Dr. R. W. Bancroft.

STAGES IN THE simulated flights—compared to normal, ground-level atmospheric conditions of 20 per cent oxygen, 79 per cent nitrogen, plus other gases, at 14.7 pounds per square inch (psi) pressure—were:

- Four hours breathing pure oxygen at ground pressure, to wash nitrogen out of the system.
- Two and a half hours breathing pure oxygen at five psi, the current U.S. spaceship atmosphere, to simulate a flight in a Gemini capsule to rendezvous and dock with an orbiting MOL.
- In one of the three flight patterns, 15 minutes of pure oxygen at 3.5 psi, the environment of U.S. space suits. This phase, with knee-bends and push-ups to simulate exertion in space, represented transferring from the Gemini to the MOL. Other flights skipped this phase, evidently assuming possibility of direct entry as through a proposed Gemini heat shield tunnel.
- Four hours simulating a shirt-sleeves stay in the MOL. In two flights, atmosphere was about half oxygen and half nitrogen at seven psi. In the third, it was a mixture of about 70 per cent oxygen-30 per cent helium at five psi.
- Two hours of work EVA, breathing pure oxygen again at 3.5 psi as in a space suit, and doing exercises periodically.

In all, out of 206 man-flights, 39 cases of bends were recorded in the work EVA phase. In contrast, only four cases of bends in 70 man-flights were recorded in the double-EVA tests' first space-suit stage, preceded by long denitrogenation.

ADDITIONAL FLIGHTS tested effects of pre-breathing pure oxygen for half an hour in the MOL to wash out possible bends-producing gases before the work EVA phase.

"There is only a marginal benefit from oxygen pre-breathing," Maj. Beard said. She would like to study this aspect of the problem further, testing effects of a full hour's oxygen pre-breathing.

As expected, the researchers said, there were fewer cases of bends in going to the work EVA stage from the five psi tentative MOL atmosphere than in the greater change from the seven psi atmosphere.

In the continuing debate over which atmosphere the MOL should have, this might be counted a point for sticking to the present low-pressure level. But there is another consideration, Maj. Beard pointed out.

Men who developed bends in the tests were treated by driving the bubbling gas back into solution through return to higher pressure, and use of pure oxygen. A special chamber capable of high pressure treatment is kept ready nearby, she said, but it has not been needed.

"We have had some men who have required ground-level (pressure) plus time for bends recovery," she emphasized.

(continued next page)

Bends Posing Space Problem

This leads to an observation not part of the researchers' formal report to be presented to Aerospace Medical Association at Las Vegas, Nev., in April, an opinion taking shape with experience:

"Medically, we would like to see, for the sake of the man who gets bends, a seven-psi ship . . .," Maj. Beard said.

SPACE SUITS, normally kept at 3.5 psi because ballooning and stiffening effects of higher pressure make use awkward, can in an emergency be inflated to seven-psi pressure, she explained.

That pressure, with seven-psi cabin pressure added, could return a spaceman with the bends practically to ground-level pressure, which some have needed.

The researchers made no recommendations either on helium use or on MOL atmosphere in general. They are moving on with their work. There is a lot to be done before the first scheduled manned MOL mission in 1968.

In a new test series begun last Tuesday, men are breathing oxygen for an hour and a half and going directly to space-suit conditions for varying periods, with exercise.

Those who get bends are brought to five psi for treatment. This pressure, plus normal space suit pressure, brings them "down" from equivalent of 34,500 feet to 14,000 feet altitude.

The question, said Maj. Beard, is this: "How long must a man stay in the laboratory under treatment before he can successfully go out into space again?"

SPACE-WALK PUZZLE—When Astronaut Edward White took his famed space walk last June, he breathed pure oxygen in the spaceship and in his suit. If future spaceships go to a different atmosphere of either nitrogen-oxygen or helium-oxygen, how much risk of bends would space walkers run? School of Aerospace Medicine researchers are finding that a troublesome question to answer.

SPACE MEDICINE

AF Completes 70-Day Inactivity Study

The Air Force has concluded a 70-day experiment on the effects of inactivity using five volunteer subjects with age, training and experience qualifications similar to those of astronauts. The men were confined to complete bedrest for six weeks, during which blood tests were taken daily to study blood cell formation and rate of red-cell destruction under inactivity conditions. Calcium studies also were conducted. Results are now being analyzed.

Animals Survive 236 Days in 100% Oxygen

Experiments at the Aerospace Medical Research Laboratories' Toxic Hazards Division indicate that survival under long-term exposure to a pure oxygen atmosphere at reduced pressure of 5 psi is indeed possible. More than 100 animals—including mice, rats, dogs and monkeys—spent 236 days in an altitude chamber and showed normal results from blood-count and chemistry tests. Although 11 rodents died during the time, the survival rate was better than in the control group, and was not considered unusual in long-term experiments with such animals.

AF Reports on Confinement Tests

The Air Force's Aerospace Medical Research Laboratories reports that there seem to be no problems with prolonged periods of restricted human physical activity, provided sufficient exercise is available to maintain metabolic efficiency. In a recent series of tests, three groups of four men each were confined for 28 consecutive days, exercising regularly on a bicycle ergometer. In general, the prolonged confinement caused no significant measurable physiological changes from control values recorded before the test, the Air Force asserted.

SAM Produces Space Dental Kit

A dental repair kit for astronaut use is being tested by the Air Force School of Aerospace Medicine in a 12-day simulation chamber training test. Developed under the direction of SAM's Dr. James Hartley, the 1.3-lb. kit is being proposed for possible use in orbital spaceflights of long duration. Dental troubles such as a gum infection, trench mouth and a filling break delayed three chamber simulations at SAM, provoking the research. The kit includes forceps to pull teeth, local anesthetic and filling material to permit one astronaut to perform emergency dental work upon the other.

missiles and rockets, April 18, 1966

Life Support

Air Force To Use Gemini Suit For Extravehicular Operations

by Heather M. David

WASHINGTON—The Air Force has contracted with the David Clark Co. for *Gemini* extravehicular spacesuits, which apparently will be the basic uniform for manned operations in the immediate future.

The Air Force, however, although it has released no details on modifications, has indicated it would like to have a better thermal protection system, as well as less bulky garments, to protect against micrometeorites and radiation.

A number of in-house efforts are in progress at Brooks AFB, Tex., (M/R, April 25, p. 39) on new concepts of cooling and pressurization which might afford better mobility, and a study of the entire field is being put together with recommendations for the future by a contractor for the Aerospace Medical Research Laboratories.

For the time being, however, officials say the *Gemini* suit appears well fitted for some of the repair and rescue and extravehicular experiments the Air Force has in mind. At present there is no specific interest in a hard suit such as that being developed for NASA by Litton Industries, since the Air Force has no mission to land on the Moon or another planet.

The Air Force is still wrestling with the knotty problem of which combination of atmospheric gases to use in the *Manned Orbiting Laboratory*.

A decision on an oxygen/helium atmosphere at 5 psi was nearly firm some months ago, but a series of several hundred experiments on decompression from this atmosphere to the pure-oxygen, 3.5-psi atmosphere which would be used in spacesuit operation has muddied the picture considerably.

These experiments, carried out at the School of Aerospace Medicine by Dr. Thomas Allen and WAF Maj. Sarah Beard, showed that the decompression from helium/oxygen produced even a greater number of bends than did the same pressure-drop ratios from nitrogen/oxygen. However, in spite of the new evaluation of the bends problem, little thought is being given to sticking with the pure-oxygen atmosphere used by NASA for the *Gemini* program.

The environmental control system contract with Hamilton-Standard Div. of United Aircraft includes evaluation of both nitrogen and helium as a diluent.

Regenerative systems—While the Air Force has been a leader in development of regenerative subsystems for life support in space, the day when such a method actually will be used apparently is far distant.

Present thinking is in favor of the resupply of oxygen and other necessities in orbit, rather than regeneration from wastes in a closed-cycle system. Systems currently in design could provide subsistence for 60 days without resupply, Air Force officials feel.

Should a mission have to go six months in orbit without resupply, they feel a tradeoff point might be reached at which a regenerative system should be installed. A number of companies are working on study contracts for various aspects of regenerative systems.

Trace-contaminant control—The materials and trace-contaminant laboratories located at Wright-Patterson AFB, Ohio, will be the center of evaluation of materials for use in Air Force vehicles.

Here, in closed chambers called "Thomas Domes" after their designer, Dr. Anthony Thomas, materials and subsystems can be run at various pressures and in various atmospheric mixtures to determine their exact outgassing properties and possible contamination problems.

While catalytic burners have been suggested for Earth-orbital missions, the Air Force reports that no decision has yet been made on trace-contaminant control, although the problem is recognized and a positive approach will be taken.

Biomedical monitoring—While the Air Force philosophy generally favors minimal monitoring, some physiological research monitoring is expected when longer in-orbit times are achieved.

The Air Force is most interested in monitoring devices which will be the least restrictive and annoying to the space crew, such as the incorporation of electrodes into helmets and other gear.

The AMRL labs at Wright-Patterson are developing a cigarette-package-sized electrocardiogram monitor, and other work on microminiaturization is going on at Holloman AFB, N.M., and Brooks AFB.

Parameters expected to be measured include the standard physiological measurements such as electrocardiogram, electroencephalogram, respiration, pulse and galvanic skin response.

Also being examined is the question of biomedical research in the longer missions, including the possibility of chemical analysis of body fluids in orbit.

While the NASA/DOD agreement on the *Biosatellite* largely rules out any experiments on large animals in Air Force Earth-orbital missions, it is very likely that some biologic experiments will be carried, depending upon the state of the art of such experiments and the nature of each mission.

Restraint systems—Current plans are for *MOL* astronauts to sleep in

Pre-test checkout of "iron pants" thermal outer garment developed by Air Forc Materials Laboratory at Wright-Patterson AFB. Suit is designed to protect astronau from 1,200°F gas plumes of the Astronaut Maneuvering Unit's jet thrusters.

hammock-like devices while in orbit, although no testing of such devices has yet been done in weightlessness.

Restraint at the work area is expected to be provided by toe holds and hip restrainers, and various strap devices also are being looked at. The standard *Gemini* couch will be used during re-entry.

Future research—The Air Force is stepping up its efforts in a number of areas in support of space missions throughout its Aerospace Medical Division.

The basic problems of weightlessness—studied through bedrest and immersion—continue to be of prime importance at the School of Aerospace Medicine at Brooks AFB.

Work on decompression, as well as sophisticated psychological and psychometric studies, is being carried out with chimpanzees at the Aerospace Medical Research Laboratory at Holloman AFB.

New emphasis is being put on research on the effects of various areas of the electromagnetic spectrum. While some aspects are classified, it is known that the Air Force is considering use of advanced electro-optical sensors aboard *MOL*, and may also be considering test of a new thermoelectric radioisotope unit under development for the AEC for eventual power supply purposes.

Research on radiation and radiation protection by pharmocological means, shielding and the like, also is receiving emphasis and will be greatly enhanced with the completion of a new bionucleonics laboratory at the School of Aerospace Medicine at Brooks (M/R, Nov. 15, p. 34).

Other research areas of prime importance, AF officials say, are long-range psychological studies on man, the effect of diurnal cycles and lack of an Earth day-night reference on man's ability to work efficiently, and nutrition problems.

Also one of the most important problems, top officials say, is that of waste disposal. What the Air Force would really like to see, officials say, is a disposal unit as big as a cigarette package which would obviate the storing of waste material on long-term missions.

Expansion—While the diversion of funding to Vietnam is affecting the rate of expansion of the Aerospace Medical Division, some new facilities are being planned in support of current programs.

One under way is a new impact facility at Wright-Patterson AFB. It will permit more precise duplication of the exact vibratory stresses which crewmen will undergo in flight, both from booster engine and aerodynamic sources. ◻

MOL STANDARDIZED CALL/TRIP REPORT

Customer/Prospect Name (1) Space Systems Division (15)

Individual(s) contacted (16) Colonel A.I. Karstens, Asst for Bioastronautics and Aerospace Medicine, AMD (59)

Your Name (60) C. B. Brown (70) Date (71) 6/2/66 (76)

Summary of Facts Covered:

Purpose of the trip was to explore bio-med requirements for MOL. Colonel Karstens was very warm and friendly as opposed to the previous call two months ago. We covered IBM's interest in the medical field and reviewed some of the programs that IBM had worked on in the past. I informed him that we were organizing some presentations for Dr. Danford of AMD, San Antonio, when he visits Los Angeles in July. I asked Colonel Karstens if he could be available to attend these presentations also. He agreed that he would be most interested and was particularly interested in a 2250 demonstration at the same time.

He asked me to write a letter outlining in some detail the presentations we wanted him to hear and the approximate date they would be made. I will send him this letter the week of June 6.

Colonel Karstens stated that they are more interested in the environmental conditions of the laboratory than the man, himself, in the MOL program. He said that if the laboratory conditions were within the limits established for the safety and well-being of the astronaut, they could be reasonably sure the astronaut, himself, was okay.

I have covered this call with Paul Tobias and asked his cooperation in helping us get together our presentation for Dr. Danford and Colonel Karstens. We plan to establish the agenda for the presentations the week of June 6.

C. B. Brown

CBB/lr

cc: Mr. H. G. Botard, GEM Region
Mr. W. B. Gibson, Local
Mr. J. P. Jones, FSD
Mr. J. R. McSween, San Antonio
Dr. B. W. Randolph, FSD
Dr. P. R. Tobias, FSD

CUSTOMER NAME:	Eglin Air Force Base Eglin Air Force Base, Florida Area Code 904/ No. 881-6668
REGION:	Midwestern
DISTRICT:	21
BRANCH:	Mobile
BRANCH MANAGER:	W. C. Stiefel
DP SALESMAN:	J. H. Jones, Jr.
SYSTEMS ENGINEERS:	J. R. Kerr R. E. Ballow G. D. Yates
FSD REPRESENTATIVES:	None
OTHER IBM PERSONNEL:	K. G. Saley, FE Field Mgr. 10 Customer Engineers

A. 1 Personnel Profile

Major General James E. Roberts - Center Commander

Not impressed by - not interested in data processing. One invitation to an ECC class has been given. He could not attend at the time.

Not a technical man - his former deputy was and he left after some conflicts on policy.

Colonel Fred Moore

Twenty-one or twenty-two years in grade as a full colonel. Good tennis player, musician, ham operator, and competitive race car driver.

Chief of Engineering Directorate

Now vacant - William McGraw was in this position before moving to location on the west coast.

VITRO Corporation operates the range facilities for this directorate. They operate radars, theodolites, communications and telemetry stations.

B. Background

B.1 One of the radar stations serves as the range control center at Eglin and is also the Tracking Station 17 of the manned-space projects. This station performs the same as any of the other mandatory tracking stations in the international tie-in.

Located at the station are four FPS-16 radars. At least one, and I suspect more than one, of these FPS-16 has the most recent power modifications to increase the range significantly.

During a manned space shot, the data control computer at Eglin is not on line at all.

The range facilities at Eglin are tied to the data control computer. We can accept data in real-time from most of the range radars and a 60 ft. tracking telemetry disk. We can also pre-position range radars and control radar searches by use of our 7094II.

B.2 IBM Equipment

Data Control

7094 II

2 Channel
18 tape - 729IV
Card Reader
Printer (with clock)
Sage Mode
DDC - The DDC interfaces with some 16 equipments built by other manufacturers. The interface is through a passive multichannel switching system built by Milgo.

2 Printer 1401

1 - 1402
2 - 1403 - 600 LPM
4 - tapes
8K

1 Printer 1401

4K
3 - tapes
1 - 1403 - 600 LPM
1 - 1402

2nd 7094II due in first quarter of 1966

2 Channel
8 tape
Card Reader
Printer (with clock)

Utilization of the installed 7094II for the month of November was 602 clock hours. Have approximately 3,000 hours of backlog.

This entire facility will come out for bid in April, 1966.

Also installed at Eglin:

1410 T/R system with 1301 and TP for management applications.

On order to be installed at Eglin:

AFWET - Air Force Weapons Effectiveness Test

Real time testing of up to 16 airborne and 10 ground weapon systems with the computer determining "hits" and notifying all concerned of "hit" targets. Joint effort with Raytheon, Hayes Aircraft and Vitro.

IBM Equipment -

2065
2860-3
1442
2821-2
1403-3
2 - 2311's
1 - 2401-3
1 - 2403-3
1 - 2803

Also on order are 2 Model 65's to be installed in the Bendix phased-array radar FPS-85. These and a Model 30 will be installed during fiscal year 1967.

C. Current Status

C. 1 Major proposal effort was a no-bid technical report to the Air Force on IBM project FORCE. This was for replacement of the data control computer. It will come back out for bid in 1966. Only one manufacturer submitted a bid to replace the four 7094's involved - (Eglin, Wright-Patterson, Edwards and BSD). That manufacturer was CDC and they failed to demonstrate the 26 bench marks successfully.

E. IBM Strategy

Air Force program and all concerned local reps are staying aware of the second attempt to create "specs." We are also praying for delays in this preparation. You might help here.

F. Schedule of Key Target Dates

Doesn't affect MOL, but the "specs" will most likely appear before August 1966.

G. Competition

CDC - probably hottest.

G. E. -----
Remington--Toss-up for second until we see the new "specs"

DOUGLAS AIRC. FT COMPAN

Missiles and Space Systems Division	S. ta Moni , Calif. Cu r Cit Calif. Hun gton ach, Calif

IBM Coverage

District 20

Branch Office-	L.A. Scientific Los Angeles Aerospace Bldg.
Branch Manager -	Cal Thimsen
Acct. Mkt. Mgr. -	Bill Mais
Senior Marketing REp.-	Bernie Rucks
MSSD Team Leader -	Tony Monaco
MSSD Marketing Reps.-	Ron Hillblom, Bill Hess
FSD Representative -	Bill Hubbarth - Manager Mission Simulator Project (located at Douglas Aircraft Co) John Jones, Los Angeles.

A. Douglas MOL Organization

Vice President
MOL Subdivision - R.L. Johnson

Assistant to Vice President
MOL Advance Mission Office - G.V. Butler

Director
MOL Configuration Management - G.G. Wray

Manager
MOL Program Security & Adminiswtration - J.P. Chilton

Director
MOL ENgineering and Integration - DR. A.F. Johnson

Manager
MOL System Engineering - S.M. Robinson

Manager
MOL Development Engineering - F.W. Murphy

Director
MOL Orbiting operations & Support - J.S. Sogg

Director
MOL Procurement and Production - S.P. Dillon

DIrector
MOL Vehicle Flight Rediness and Product Assurance - S.D. Truham

Director
MOL Program Control - G.J. Askew

B. BACKGROUND

B.1 Role in MOL

Douglas is the prime contractor to the Air Force for the MOL Orbiting Vehi le. This includes the Vehicle, Crew living quarters, Crew working quarters or laboratory, Life supprrt systems, Data systems and Data Management, Systems integration, and Mission simulation. The On board experiments (payload), are being provided by General Electric by a prime contract to the Air Force.

IBM is vitaly interested in two of the ground support activities associated with Douglas's role in the MOL Program.

1. Vehicle Check Out

We have had no significant involvement in this area to date. This will require a significant amount of computing equipment, and represents an opertunity to get into an area where competative equipment has been heavily used.

2. Mission Simulation

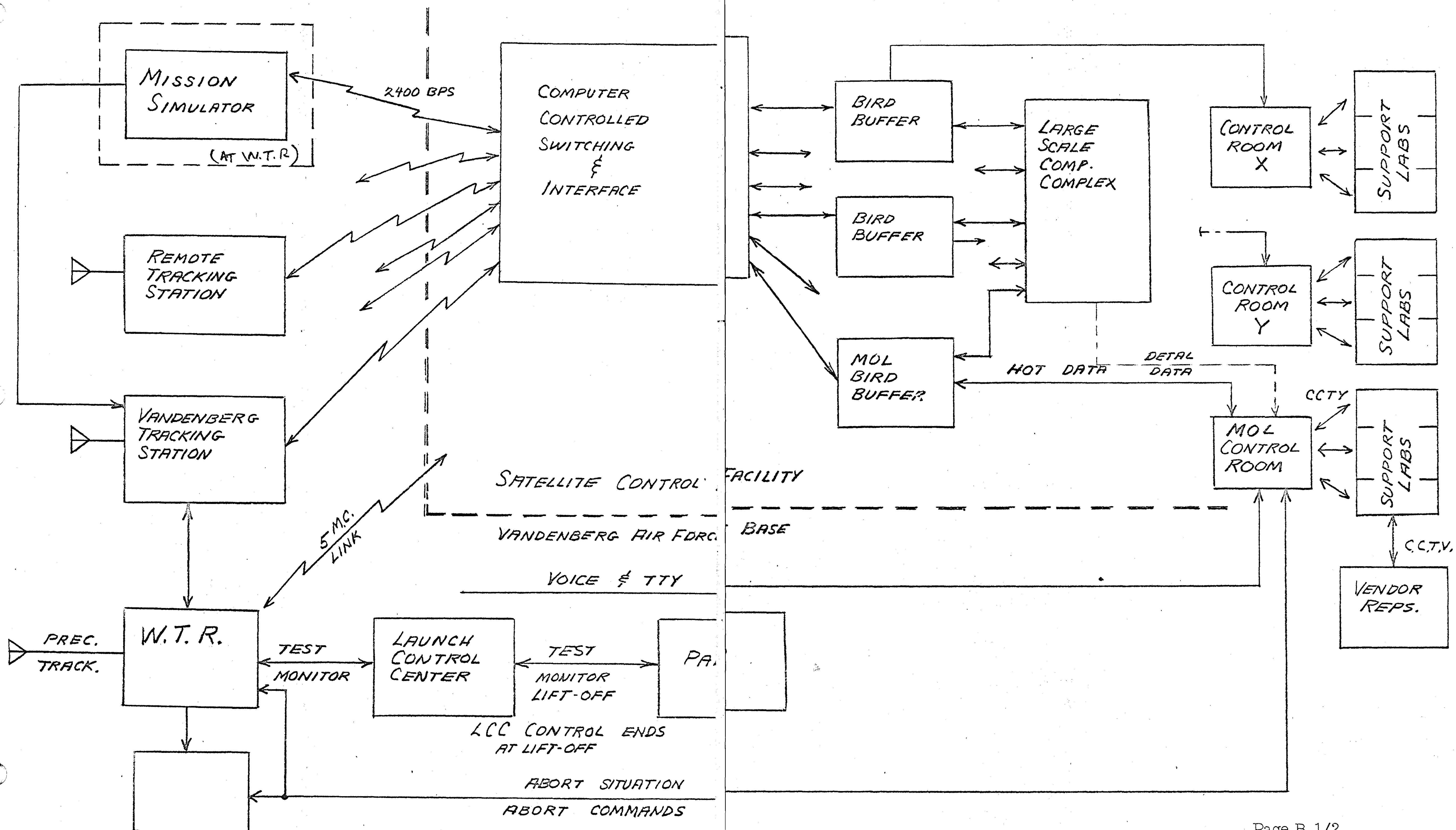
The primary purpose of the mission simulator will be for crew training, (both flight and ground crews). However it will also be required for on orbit support functions such as contingency rescheduling, re-entry rehersal, and malfunction analysis, as well as post flight analysis.

The simulator will include vehicle replicas, instructors control consoles, local and remote visual displays, experiment simulators, GFE Gemini simulator, and a computer or computers.

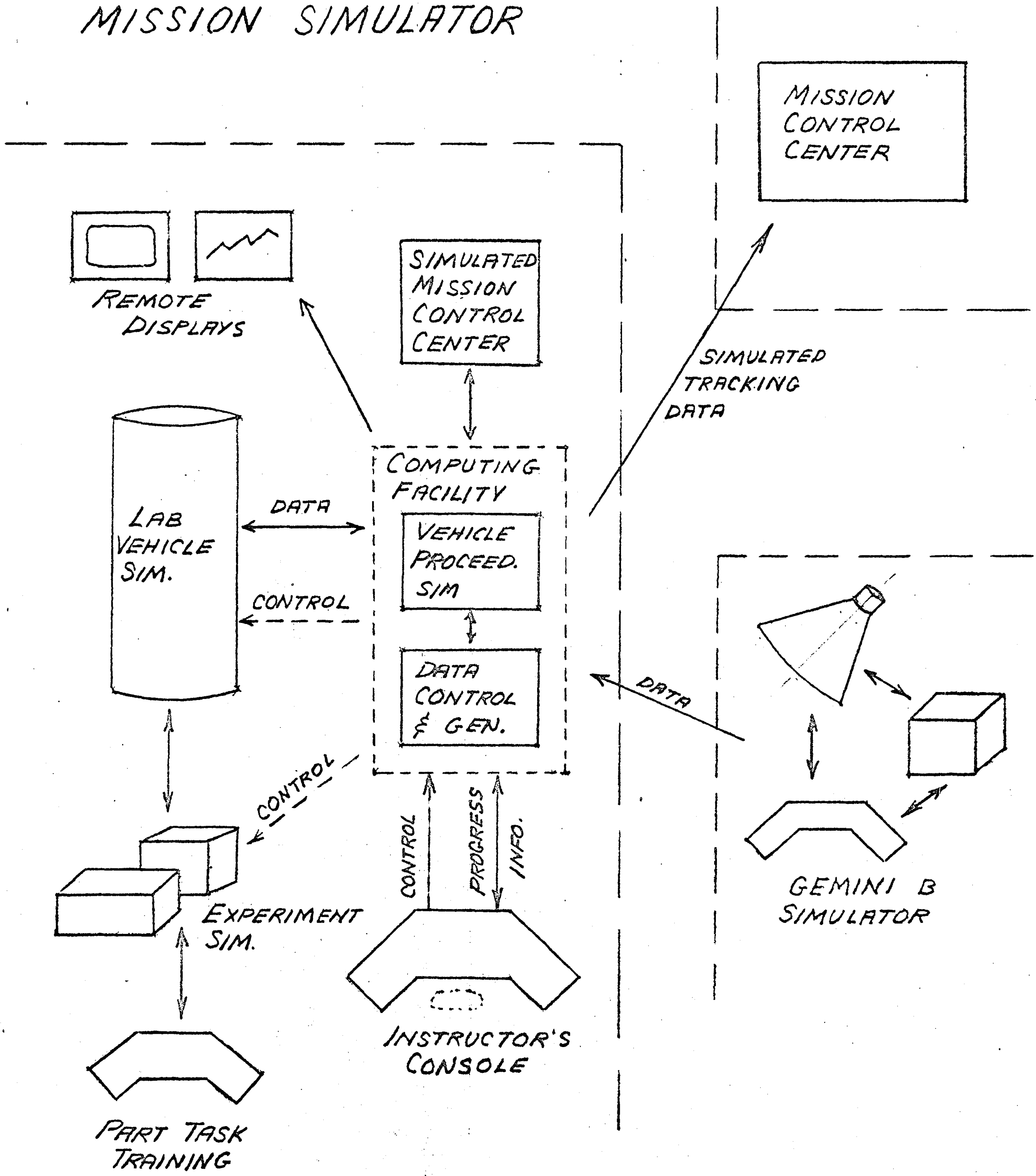
A large scale computer will be required to handle various functions: Simulation of the on board computer, simulation of the external environment, interface to experiments, consoles, displays, and Gemini simulator, Simulation monitoring, data reduction and evaluation.

Two Mission simulators will be required. One will probably be located at Douglas and the other at Vandenberg Air Force Base. The One at Douglas will be used for Check out of equipment and programs, and for flight crew training, The simulator at Vandenberg AFB Will in addition be used for ground crew training and for total flight rehersals.

M.O.L. GROUND SUPPORT



MOL MISSION SIMULATOR



B.2 Equipment Installed - Douglas MSSD

IBM Systems Installed

4 - 7094-I
2 - 7010
3 - 1460
4 - 1401

One 7094 is purchased, the rest of the equipment is rented.

Total system points installed - 400,000

IBM Systems on order

8 - System/360 Model 20
5 - System/360 Model 30
7 - System/360 Model 50
2 - System/360 Model 65

It is expected that the number of Model 50 systems will be adjusted downward thd the number of model 65 systems will be increased.

Competitive Systems Installed

There are several small and intermediate systems (CDC 160A - 924 type) used for data reduction and conversion and for systems check out.

Bendix-CDC G-15's are used in several locations for quick access computing.

A considerable amount of time is being purchased on a CDC 3600 for running large FORTRAN jobs, but no large scale competitive systems are now installed.

C. CURRENT STATUS

C-1 Proposals Outstanding

IBM Federal Systems Division Currently has proposals into Douglas for the Data Management and Mission Information Systems. Decision on these is expected immenently.

C-2 Current Activity

FSD is currently working on a funded study contract to develope specifications for the MOL Mission Simulator. This study is expected to last until early 1966, at which time there will be an RFP for the simulator. Other participants in the study in addition to the Douglas and Ibm Groups are: Link, General Electric, and Mesa Engineering. IBM however Has the major share of these sub-contracts.

Bill Hubbarth, IBM FSD Owego, is in charge of this study for IBM, and has about six people located at Douglas as well as numerous people in Owego.

MOL MISSION SIMULATOR

STATUS:

- Under Contract to DACo for Definition Phase.
- Just extended five weeks to February 25, 1966.
- $130-135K.
- Total of fourteen people in Program.

PHASE II PROGRAM FOR IBM

- Douglas "Make" for total MS. ($43 million total MS Estimate)
- Competition - March & April.
- IBM Major Thrust for MS Data Handling System - $14.2 million.
  - Computer Complexes

    2 360-65's

    4 360-50's

    2-4 1800's

    ($8 million)
  - Instructor Consoles

    8 2250's

    Special Hardware

    ($.7 million)
  - Software

    100-150 man years

    ($3-4 million)
  - MS System's Engineering & Support

    ($1-1.5 million)

COMPETITIVE STATUS

- IBM Equipment being used as baseline.
- IBM receiving 2 to 1 more money than Link, PRC.
- PRC wants software-historical relation to DACo.
- CDC Background in DACo, PRC.
- Tied to DMS.
- DACo concerned about 360 delivery.
- IBM has been major source of MS requirements definition.

CURRENT APPROACH

- Strong role in MS Specification.
- Major software planning effort underway.
- Major effort in Instructors Console.
- Attempt sole source.

D. PROBLEM AREAS

The current problem area is associated with the Simulator study. The Study is proceeding according to the contract schedule. However, much of lthe data necessary is not yet available, and many necessary decisions are not yet made. This necessitates the making of judgement decisions in the simulator design which may well be subject to major when the facts all all available. Areas where information is lacking include: Mission Payload, and Onboard computer where the winning design is not known.

Conference Notes - Discussion regarding Douglas Checkout requirements Document #A3-802-E100-12 of January 6, 1966.

Attendees: C. B. Brown, G.C.Boruski, K.Gajewski, W.Gourlay,Jr., R.C.Heath, A.J.Monaco, F.X.O'Rourke, A.L.Ryff, L.Stoller, J.Sugi, C.D.Thimsen.

1) Page 2 of this memorandum summarizes pertinent conclusions arrived at after analysis of the Douglas Technical Guidelines document for a computerized checkout complex.

2) Page 3 tabulates some major technical problems associated with implementing the requested approach using IBM equipment.

3) At the conclusion of the meeting it was agreed that an effort would be made to respond at least to the preliminary request by Douglas. It was further agreed that initial meetings would be scheduled with Douglas personnel as soon as possible, in that a competitive analysis would be completed to establish cost guidelines, using the SDS 9300 versus both the 360/44 alone and the 360/44 with an 1800 front end.

F. X. O'Rourke

FXOR:jh

cc: W.B.Gibson, J.E.Hamlin, W.Hess, J.P.Jones.

SUMMARY

1. Requirement seems to be generated around specific computer (SDS 930 or 9300).

2. Well suited for checkout application. Obviously generated using SIVB background and personnel.

3. Implementation of such a system would require significant FSD support.

4. Delivery cycle most probably would not exceed 12 months even if MOL slips further.

5. To respond would require commitment of at least 4 360/44 systems and up to (8) 1800's.

6. Response would require high level engineering liaison with Douglas for next 6-8 weeks.

7. Present efforts here (DIMAC) dovetail very well with Douglas basic requirement.

8. Must make decision whether to:

   a. Respond
   b. Level of response
   c. Availability of 360's/1800's.
   d. Availability of engineering (FSD)
   e. Funding

9. If we are going into checkout, we must start here. This will require equipment committed for checkout only.

Requirements	360/System	360 + 1800 Front End
1. Independently addressable memory modules	Cannot be handled per se	Can handle actual requirements
2. Memory expansion to 65K	Cannot fulfill as portion of this capability used to meet peripheral requirements	Can meet and exceed requirements
3. Memory operation/external equipment	Cannot handle completely - partly satisfied by RPQ	Requirements met with RPQ
4. Auxiliary storage (SDS 9300 type requested)	Cannot meet access time with disc. Using drum cannot meet transfer rate.	(Same as 360)
5. Program I/O channels (24 bit parallel - minimum rate 100K words/second).	Requires RPQ	Requires RPQ
6. Telemetry channel with DDAS type buffering.	Requires RPQ for input + assignment of some 360 memory as buffer.	RPQ for Channel 1800 memory as buffer (will meet highly probable expansion requirements
7. Buffered Display output - highly probable same requirement to work with existing displays at test site only.	Requires 2250 display concept with some interface RPQ	(Same as 360)
8. Test Equipment Interface	RPQ required	RPQ required
9. DO/DI requirements	RPQ required	RPQ required
10. "Nested" priority interrupt (10 levels requested.)	360/44 cannot meet requirements as stated. RPQ route may be difficult.	1800 system can handle basic requirements
11. Instruction Interrupt (unique instruction related to particular line)	RPQ, possibly dealing with basic logic, required.	1800 can handle most of requirements
12. Paper tape punch	Externally purchased equipment	(Same as 360)
13. Memory incrementing	Not in 360/44 repertoire	Not in 1800 repertoire

February 8, 1966

TRIP REPORT - DOUGLAS, HUNTINGTON BEACH

Re: Douglas Checkout System Meeting, February 7, 1966

Attendees:
T. J. Eason - MESA
J.H.Lane - Douglas
A. Monaco - IBM
J. Sugi - IBM
J.Jones - IBM
C. Brown - IBM
R. Heath - IBM
F.X.O'Rourke - IBM

1. GENERAL RESULTS:

Douglas, over the past eight months, has worked very closely with MESA personnel and three computer manufacturers (CDC, SDS, CCC) in optimizing digital hardware for implementation of a "Modular Unified Checkout Concept". A well-qualified group of programming consultants (MESA), together with their own systems group (experienced in SIVB checkout problems) have completed definition of the Douglas MOL checkout concepts. The actual specifications for this hardware have been written by MESA with T. J. Eason responsible for its final generation. IBM was not a participant in any phase of this effort.

During the discussion (approximately 52 minutes) the following specific points were presented by Mr. Eason of MESA Corporation:

a. The resultant checkout concept is directed towards a unified system which is partially modular in design. They feel the system is capable of integration with future checkout requirements.

b. The system is intended for installation at three sites (pricing for up to six systems has been requested by Douglas).

c. The system will be required during the vehicle launch countdown operation. Therefore, it could eventually become a "launch critical" system, similar to APOLLO SLCC at Cape Kennedy.

d. Prime software goal for this system is to produce a test engineer oriented launch language similar to STOL or ATOLL with on-line capabilities to modify and assemble test procedures, utilizing personnel with little or no training in digital computers or programming fundamentals.

e. The system as planned will accommodate all of the Douglas MOL checkout requirements (including the data management package).

f. The hardware interface will have to be such that the system will be capable of working with Douglas developed operator consoles and color displays.

g. As presently configured, the system does not have a program regeneration requirement and the specification currently being processed for transmittal to vendors does not have any specific hardware requirements oriented towards error recovery procedures.

h. The specification is limited to hardware requirements only. No RFP regarding the associated software package will be generated, as current plans are for Douglas system personnel to handle this task directly with possible sub-contracts to MESA Corporation for additional programming help, if needed.

i. Consideration will eventually be given to utilize this system as the Central Computer and monitor element to service remote display facilities at the launch site.

j. The final specification (assumed to be part of the forthcoming RFP) has been completed and should be ready for issue from Mr. Hansen's (Douglas) office in about two weeks.

k. Mr. Eason stated that the drum requirements specified in the initial technical guidelines document was indeed required for the application for which this system is intended, and data transfer rates below 200,000 words per second would be unsatisfactory.

l. Mr. Eason also stated that the expandable memory requirement should provide a capability for increasing the memory from 32K to 65K on site with approximately two to three days of down time.

m. Mr. Eason stated that the final specification would be almost identical to technical requirements presented in the guidelines document (of which we have a copy). He further noted that there would be little or no additional requirements in the specifications related to hardware requirements other than normal "boiler plate" items normally in a formal RFP.

2. SUMMARY:

The Douglas system design has progressed to a point where associated Douglas engineering personnel are completely sold on the concept proposed in the technical guidelines document and any attempt to seriously influence a modification of the overall concept would have little chance of success.

Within the present IBM structure, it will be impossible to generate either a reasonably competitive bid or a suitable technical response to the Douglas requirements for the following reasons:

a. IBM does not have existing equipment capable of meeting the basic requirements of the Douglas specification (see conference notes, Douglas checkout requirements, F.X.O'Rourke, dated 31 January, 1966).

b. A system configuration only approximating the basic requirements has been conservatively priced out at about twice the price of other vendors currently under active consideration by Douglas.

c. Engineering rapport with Douglas checkout personnel is non-existent at this time.

d. The engineering effort required to generate a representative response to any Douglas RFP would require a considerable expenditure of IBM marketing/Engineering funds which, as of this writing, are not available for this task.

3. RECOMMENDATION:

The Douglas portion of the MOL checkout market has been formulated to a point where any further effort by IBM to break into this market would be of little consequence. The writer therefore recommends that no detailed engineering effort be continued by IBM for purposes of capturing the Douglas portion of the MOL checkout market.

for W. Gourlay

F. X. O'Rourke

FXOR:jh

cc: J. E. Hamlin,
W. B. Gibson,
Attendees,
W. Gourlay.

February 8, 1966

TRIP REPORT - DOUGLAS, HUNTINGTON BEACH

Re: Douglas Checkout System Meeting, February 7, 1966

Attendees:

T. J. Eason - MESA
J.H.Lane - Douglas
A. Monaco - IBM
J. Sugi - IBM
J.Jones - IBM
C. Brown - IBM
R. Heath - IBM
F.X.O'Rourke - IBM

1. GENERAL RESULTS:

Douglas, over the past eight months, has worked very closely with MESA personnel and three computer manufacturers (CDC, SDS, CCC) in optimizing digital hardware for implementation of a "Modular Unified Checkout Concept". A well-qualified group of programming consultants (MESA), together with their own systems group (experienced in SIVB checkou problems) have completed definition of the Douglas MOL checkout concepts The actual specifications for this hardware have been written by MESA with T. J. Eason responsible for its final generation. IBM was not a participant in any phase of this effort.

During the discussion (approximately 52 minutes) the following specific points were presented by Mr. Eason of MESA Corporation:

a. The resultant checkout concept is directed towards a unified system which is partially modular in design. They feel the system is capable of integration with future checkout requirements.

b. The system is intended for installation at three sites (pricing for up to six systems has been requested by Douglas).

c. The system will be required during the vehicle launch countdown operation. Therefore, it could eventually become a "launch critical" system, similar to APOLLO SLCC at Cape Kennedy.

d. Prime software goal for this system is to produce a test engineer oriented launch language similar to STOL or ATOLL with on-line capabilities to modify and assemble test procedures, utilizing personnel with little or no training in digital computers or programming fundamentals.

e. The system as planned will accommodate all of the Douglas MOL checkout requirements (including the data management package).

f. The hardware interface will have to be such that the system will be capable of working with Douglas developed operator consoles and color displays.

g. As presently configured, the system does not have a program regeneration requirement and the specification currently being processed for transmittal to vendors does not have any specific hardware requirements oriented towards error recovery procedures.

h. The specification is limited to hardware requirements only. No RFP regarding the associated software package will be generated, as current plans are for Douglas system personnel to handle this task directly with possible sub-contracts to MESA Corporation for additional programming help, if needed.

i. Consideration will eventually be given to utilize this system as the Central Computer and monitor element to service remote display facilities at the launch site.

j. The final specification (assumed to be part of the forthcoming RFP) has been completed and should be ready for issue from Mr. Hansen's (Douglas) office in about two weeks.

k. Mr. Eason stated that the drum requirements specified in the initial technical guidelines document was indeed required for the application for which this system is intended, and data transfer rates below 200,000 words per second would be unsatisfactory.

l. Mr. Eason also stated that the expandable memory requirement should provide a capability for increasing the memory from 32K to 65K on site with approximately two to three days of down time.

m. Mr. Eason stated that the final specification would be almost identical to technical requirements presented in the guidelines document (of which we have a copy). He further noted that there would be little or no additional requirements in the specifications related to hardware requirements other than normal "boiler plate" items normally in a formal RFP.

2. SUMMARY:

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Within the present IBM structure, it will be impossible to generate either a reasonably competitive bid or a suitable technical response to the Douglas requirements for the following reasons:

a. IBM does not have existing equipment capable of meeting the basic requirements of the Douglas specification (see conference notes, Douglas checkout requirements, F.X.O'Rourke, dated 31 January, 1966).

b. A system configuration only approximating the basic requirements has been conservatively priced out at about twice the price of other vendors currently under active consideration by Douglas.

c. Engineering rapport with Douglas checkout personnel is non-existent at this time.

d. The engineering effort required to generate a representative response to any Douglas RFP would require a considerable expenditure of IBM marketing/Engineering funds which, as of this writing, are not available for this task.

3. RECOMMENDATION:

The Douglas portion of the MOL checkout market has been formulated to a point where any further effort by IBM to break into this market would be of little consequence. The writer therefore recommends that no detailed engineering effort be continued by IBM for purposes of capturing the Douglas portion of the MOL checkout market.

for F. X. O'Rourke

FXOR:jh

cc: J. E. Hamlin,
W. B. Gibson,
Attendees,
W. Gourlay.

MOL STANDARDIZED CALL/TRIP REPORT (IBM CONFIDENTIAL)

Customer/Prospect Name (1) Douglas Aircraft Corporation (15)

Individual(s) contacted (16) ______ (59)

Your Name (60) F. X. O'Rourke (70) Date (71) April 1, 1966 (76)

Summary of Facts Covered:

During this meeting, preliminary engineering requirements for the Douglas MOL Data Reduction Task were presented to IBM by Douglas personnel. The discussions lasted approximately 2.5 hours, during which the following points were highlighted:

1. The Douglas Data Reduction Group is in the initial management approval phase of defining requirements for developing and installation of a large, comprehensive data reduction facility, utilizing a high speed general purpose computer to automate the Douglas MOL Data Reduction Task. This group presently feels the step is mandatory, due to the large amount of data to be handled. They further feel that requirements for quick look data, as well as 10-24 hour turnaround analysis functions, can only be handled by a highly automated central facility, which, at present, does not exist at Douglas.

2. They presented the following preliminary load figures for this center (which after review with the contractor and other Douglas departments were felt to be conservative).

<u>Item a</u> - The total data rate estimate;

Vibration and Acoustic Data 21.9×10^6 words per 24-hour day,
FM data 5.33×10^6 words per 24-hour day,
PCM data 60 minutes of airborne tape data plus 90 minutes of real time data daily.

Item b - Real time data input loading requirements;

1. decommutating and formatting airborne recording - 3-1/2 hours
   general decommutating and formatting - 1/2 hour
   scale conversion tasks - 1-1/2 hours.

2. End to end merge, redundant edit of overlapped airborne real time - 3 hours.
   shock and vibration analysis - 1.4 hours
   PCM event data - 1.5 hours
   Biomedical data - 1 hour
   Function merge - .25 hour
   comparison to nominals - 1 hour
   Propulsion system analysis - 1 hour
   engine analysis - 1-1/2 hours.

The above is not a complete list. The total processing requirement per day, however, did come out to 29.1 hours. If one computer system is to be used, there is a basic requirements that processing must go on while data is being input to the system and results output to the appropriate displays and recording devices. In most instances, compilation and assembly must be performed concurrently by the system.

3. They are presently planning to do a good deal of their own programming but clearly recognize the requirement for the computer vendor to provide system programming support at least during the initial phases of the system development, especially in the Monitor and operating areas of the software.

4. It was indicated the system should be fully operational by July, 1967. In this regard, they recognized the firm requirement to utilize machine time available at other locations, starting early in September, 1966, for checkout. They were especially interested in developing and expanding multiprocessing and multiprogramming aspects as a solution to this problem.

5. The IBM hardware configuration under consideration by them included a 360/44 with 65K of memory as the central processing element with one completely implemented and buffered 2250 display and one 2260 maintenance console, six to eight tape drives (4 to 6 of which would be 180 kc) and at least two high speed multiplex channels for tape and disk operations. Memory requirements of this system definitely include a large disk file to handle the many long term storage requirements (including calibration curves, reduction matrix data, engineering conversion data, etc.).

The first meeting was concluded with an agreement on the part of IBM to return the week of 28 March to become more familiar with the detailed task loading for the system. IBM would then present a proposed hardware configuration, together with a detailed outline of the required software package required to handle this task. It is apparent that during this presentation IBM must be ready to discuss details of the software support IBM feels would be necessary to handle the problem and to describe the general manner by which the software will handle the "multi-programming" requirements.

GENERAL COMMENTS

The task, as described, is comprehensive one for a single computer system. Some serious questions exist regarding the use of the 360/44 system for this task, as the monitor package associated with the 360/44 does not, at this time, have any ability to handle input and output concurrently with the telemetry processing requirements.

R. Cabaniss is presently looking into the feasibility of modifying the 360/44 monitor software package to perform this task and is planning to develop a reasonable estimate of what an effort of this nature would require in the way of manpower and time.

cc: C. B. Brown, R. Cabaniss,
W. Gourlay, Jr., W. Hess,
W. Gibson, R. Hippe, F. Mutz

F. X. O'Rourke

CUSTOMER NAME:	General Electric Company Space Technology Center Goddard Boulevard King of Prussia, Pennsylvania 19406 Telephone: 969-2005 & General Electric Company Re-Entry Systems 3198 Chestnut Street Philadelphia, Pennsylvania 19101 Telephone: 823-2005
REGION:	Eastern
DISTRICT:	5
BRANCH:	Philadelphia
BRANCH MANAGER:	R. J. Dougherty
DP SALESMAN:	F. A. Fisher

A-1 - Missile and Space Division - Plant Locations

Valley Forge Space Technology Center	P.O. Box 8555 Philadelphia, Penna. 19101
Cabot, Cabot & Forbes Complex	Spacecraft Dept., P.O. Box 8661 Philadelphia, Penna.
Philadelphia	Re-Entry Systems Dept. 3198 Chestnut St., Phila., Pa.
Burlington	Missile and Armament Dept. Lakeside Ave., Burlington, Vt.
Daytona	Apollo Support Department P.O. Box 2500, Daytona Beach, Fla.
Houston	Apollo Support Department P.O. Box 26287, Houston, Texas
Huntsville	Apollo Support Department P.O. Box 294, Huntsville, Ala.
Maryland	Spacecraft Department 4901 Fairmont Ave., Bethesda, Md.
Mississippi	Mississippi Test Support Dept. Bay Saint Lanes Mississippi
Evendale	Space Power & Propulsion Dept. Mail Drop R-2 Cincinnati, Ohio

A-1 - MOL Organization

E.A. Miller	General Manager of MOL
C.F. Hix, Jr.	Manager Design Engineering Section
R.W. Lawton	Manager Bio Astronautics Section
K. Kitson	Manager Program Management Sec.
R.G. Myers	Manager Major Sub-Contract Sec.
A.E. Buescher, Jr.	Manager Business Management
L.P. Huggins	Manager Manufacturing Section
G.E. Eastwood	Manager Systems Test & Deployment Section
E.T. Brogan	Manager Quality Assurance & Reliability
R.J. Haughton	Manager Employee & Community Relations
J.C. Hackney	Manager Finance

A-1 - PERSONNEL PROFILE

H.W. Paige	Division General Manager
E.L. Hulse	Division Financial Manager
L. Cimino	Division Manager of Information Systems & Computer Center
R. Hench	Manager of Programming
F. Garrison	Manager of 7094 Operations
M. Morton	General Manager - Re-Entry Systems
L. Cowles	General Manager - Spacecraft Department
L. Steg	Manager - Space Sciences Lab

B - BACKGROUND

B-1 Customer is a prime contractor along with Douglas Aircraft. Other programs include NIMBUS, APOLLO, SUPPORT, RE-ENTRY SYSTEMS, VOYAGER

B-2 One (1) 7094 System (main frame) approximately $60,000 month rental purchased by G.E. and sold by G.E. to third party (CEIR) - Presently leasing from CEIR. Approximately 16 Tape drives (729's) not purchased.

One (1) 7094 System (main frame) approximately $60,000 month rental. 10 Tape drives (729-6's) not purchased.

One (1) 1460 System (dual printers)

One (1) 1620 System 40K

G.E. Systems -

2-415's
1-225
1-235
2-625's (on order)

C Proposal for purchase of second 7094 System. Purchase of main frame approximates $1,350,000.

E. G.E. dedicated to ultimate replacement of IBM computers with their own. As such, we are pushing purchase of second 7094 system.

Replacement of 1620 with 1130.

CUSTOMER NAME:	The Denver Division of The Martin Company The Aerospace Division of The Martin-Marietta Corporation P. O. Box 179 Denver 1, Colorado - (303) 794-5211
REGION:	District 15, Western Region
BRANCH MANAGER:	N. H. Hawkins
MARKETING MANAGER:	Robert Umbreit
MARKETING REPRESENTATIVE:	Richard Winckler
ADVISORY SYSTEMS ENGINEER:	Jack Stunkel
MOL PROJECT OFFICE:	F. X. O'Rourke W. Gourlay

A. CUSTOMER ORGANIZATION

1. DIMAC Study

The Martin organization supports both a functional organization and a project organization. These two operate in parallel. A given effort or individual may, at various stages of a project, report through both of these channels. Martin also establishes special teams or task forces to respond to RFP's and any other requirements for special study efforts. The DIMAC effort is, at present, a special team effort being "vectored" and define by K. Gunderson.

2. General Organization

Martin Denver Divisional Vice-President - J. D. Rauth.

Executive Directors - Functional - I. N. Palley - Technical Operations
Responsible for Research, Engineering, Manufacturing, Testing, Training, Quality, Material and Procurement.
- D. S. Burrows - Management Oper's.
Responsible for Administration (D. P. Equipment), Finance, Accounting, Plans and Budgets.

General Managers - Project
- R. S. Williams - Strategic Systems (Titan II)
- W. G. Purdy - Launch Vehicles (Titan III)
- G. E. Smith - Military Space Stations (Apollo pallet).

Management Concerned with DIMAC* Effort -
W. G. Purdy - General Manager, Launch Vehicles.
D. S. Levine - Program Director, Titan III.
L. J. Adams - Technical Director, Launch Vehicles
S. F. Albrecht - Manager, Ground Electronics
W. J. Hughes - Project Engineer ILC **
D. Gray - Project Manager ILC
K. Gunderson - Senior Engineer ILC - DIMAC
B. Pennington - Senior Engineer ILC - DIMAC
J. Hoerning - Senior Programmer ILC - DIMAC

Management Concerned with Conventional DP use -
D. S. Burrows - Executive Director, Management Operations.
R. E. Weber - Director, Administration
C. Izett - Staff - Conversion Program
J. Hopko - Manager, Management Operations (Mgt. Engin.)
J. E. Feely - Manager, Computer Department
E. J. Karulf - Manager, Technical Operations (Mgt. Engin.)

* - DIMAC - Data integration and malfunction analysis computer is the computational system proposed by Martin for use in the .

** - ILC - Initial Launch Capability (ILC) ground station for T-IIIC - MOL Launch.

Air Force Management Concerned with DIMAC -
Colonel Miller (ETR Study)

Captain N. R. North - Space Systems Division (SSD SS BTA)643-1402, L. A)

Aerospace Corporation personnel Concerned with DIMAC
Jay J. Kimose (Los Angeles) Titan III G-50 - 648-5536
S. H. Lewis, Electronics Division
N. L. Gelbwaks, Electronics Division
W. Dillon ETRO - 305-853-5695

As the DIMAC effort progresses, a more detailed organizational structure will be included where it is directly related to the DIMAC effort.

DIMAC EFFORT

B. BACKGROUND

The current role of the Martin Company in the MOL Project is to provide the Titan III-C booster for launch of the MOL payload. In this regard, Martin has contracted with the Air Force to provide a proven element of the system on the basis that the Titan booster has been operationally proven over the last three years. Within this task Martin is also responsible for the checkout and certification of the booster vehicle and have stressed to the Air Force that booster reliability is not only based upon the proven components of the vehicle itself but the proven concepts of checkout and launch control techniques currently being utilized by Martin at the Cape (KSC). They, however, do recognize the need for more pertinent and timely technical information associated with vehicle checkout and launch to enhance their "launch on time" capability and speed-up existing booster checkout procedures. The Martin Company has been strongly entrenched in the aerospace booster business for the past nine years and is the prime contractor for the Titan booster vehicles currently being used on the Gemini program and as the major ICBM Air Force weapon. At present, Martin is actively engaged in production of the Titan II vehicle for the Air Force and the Gemini program. In this regard, Titan II is considered a major ICBM missile and the Titan III a vehicle being developed for USAF MOL applications and many NASA tasks (including Surveyor).

Martin-Denver has also recently been awarded a four month study contract on the order of $400,000 for the development of the Apollo extension system experimental pallet. In this regard, three other vendors have also received the study award. One of the four will be awarded the contract to develop the payload equipment for the Apollo extension effort. Martin has aligned themselves with RCA for development of the electronics and computation equipment and Honeywell for the platform and guidance systems.

It has been established that Martin-Denver will have significant responsibility at Vandenberg Air Force Base in the development of the launch and checkout procedures associated with the Titan booster vehicles they are delivering there for MOL.

Equipment Installed at Martin-Denver

There is currently over 200,000 points of IBM equipment installed at Martin-Denver. The equipment includes a 7094-2, a 7074, a 7044, 2 System /360 Model 30's, 3-1620's and 10,000 points of unit record equipment.

The following Table lists equipment installed together with monthly rental costs and application.

ITEM	NO.	MONTHLY RENTAL	APPLICATION
7094 Model 2	1	85,445	Da Processing/Engineering App'n.
7074	1	38,925	Ac nting
7044	1	34,595	Ge al
1401	1	9484	7044 peripheral
1401	1	9696	General
1620	3	5420)	
		3925)	Scientific
		5390)	
360/Model	2	7975	Data Reduction
30		6775	Peripheral Support

In May of 1965, the Martin Company (all three divisions) made a decision to replace all of the installed IBM systems with GE 635 multiprocessing systems. The planned conversion is to start on December 15, 1965, with temporary installation of a GE 625. The dual 635 system is to be installed in June of 1966. The last major IBM system at Martin is scheduled to be displaced in late September, 1966. The actual decision to utilize GE equipment instead of IBM was made by the president of the Martin-Marietta Corporation (George Bunker), overruling unanimous recommendations for IBM from each of the three divisions and the Martin Company headquarters. It is believed that this decision was the result of a close working relationship between Mr. Bunker and Mr. Raeder, President of GE Computer Division. The relationship was established during exchanges relative to the Bunker-Ramo Company, a portion of the Martin-Marietta Corporation. Bunker-Ramo and GE have entered into a series of agreements including exclusive exchange of computer patents in several joint proposals along this line.

The possibility of Mr. Bunker personally entering into the vendor decision for the DIMAC has been evaluated. It was concluded that while it is not impossible, this is a very highly unlikely probability. The DIMAC procurement itself is being handled by the engineering department of Martin. It is a procurement for hardware which is a component of a project directed and contracted for by the Air Force where the Air Force will be very close to the procurement process itself during all its phases. Under these circumstances, it will be very difficult for any direct pressure at the local corporate level to influence the final decision without this fact becoming very obvious to the Air Force itself.

In summary, while local corporate arrangements have heavily influenced IBM's loss of commercial business in the Martin area, it is not probable that any of this influence can be effectively exerted in selection of the DIMAC contract.

SECTION C CURRENT STATUS

1. General

The Martin Company-Denver has prepared a study document describing the system requirements for DIMAC. The document outlines the Martin checkout philosophy for the Titan booster and recommends an initial configuration for installation first at Denver and then at Vandenberg Air Force Base, California. The document has been reviewed and tentatively approved by the Aerospace Corporation and certain segments of the Air Force. Martin is currently awaiting final Air Force approval to go ahead with the project and finalize the system specification to issue an RFP. It is expected that the final Air Force approval will be forthcoming in late May 1966 at the earliest, in that Martin-Denver will have the RFP ready for distribution not earlier than July '66.

It is the stated opinion of Martin-Denver personnel that the Air Force is favorably impressed with their proposed passive check-out approach and they have, accordingly, estimated the following general schedule regarding the development of the system:

a. Go ahead by the Air Force - end of May, 1966.
b. Release of RFP by Martin-Denver - end of July, 1966.
c. RFP response from vendor in Martin-Denver - mid-August, 1966.
d. Evaluation of proposals - early September, 1966.
e. Selection of successful bidder by Martin procurement - early Sept., 1966.
f. Delivery of initial equipment - mid-July, 1967.

The existing study presently underway with Martin-Denver and IBM is being conducted at Cape Kennedy for the purpose of investigating the feasibility of using general purpose computers for checkout and launch of Titan III vehicle. This study has been assigned the title "OCALA" by IBM at Cape Kennedy. The effort is, in general, being coordinated from the engineering management aspect by Denver personnel, who are also implementing the applications programming portion of the effort, while the development of the monitor and executive programs for the system are being handled by IBM at Cape Kennedy. As presently proposed, the group working at Denver will transfer to Cape Kennedy early in 1966 for checkout and integration of the application programs with the equipment and monitor program. Current plans are to support two

Titan launches using an IBM 7044 and a 7288 Data Channel installed by IBM to check the utility of the system and the associated programs in the areas of limit checking of PCM data, as well as basic success criteria techniques. The first launch is expected to occur about mid-May, 1966 and the second, July, 1966. The computer itself may also be scheduled to perform some limited malfunction analysis if the study progresses as planned. The results of the study will, of course, be highly pertinent to the DIMAC system concept. Hardware associated with limit checking is currently being developed by Martin-Denver personnel using initial specifications generated by IBM. This equipment takes the form of comparator channels designed to allow high speed comparison of PCM data. Martin intends to supply two of these comparison channels for the OCALA system at Cape Kennedy. In this regard, a similar type of comparator is required for the current DIMAC configuration, and, in the event IBM produces this system, a requirement for the development of this type of a comparator as well as a more sophisticated comparator unit for discrete limit checking will have to be developed and provided.

Martin-Denver personnel have defined the system requirements for the DIMAC system in quite a bit of detail over the last six months. They have studied missile checkout specifications and existing facilities as related to their own checkout philosophy and existing Titan III-C launch equipment and have essentially finalized the concept they feel optimizes all the related parameters within the Martin structure. In essence, the Martin-Denver group has already established their needs and goals for this system and are well along in the final approval cycle. They have assumed a strong engineering approach and are actively pursuing this as their goal. If Air Force approval is received, they will respond rapidly and firmly along this general equipment vector. Due to the strength and direction provided by Martin engineering, there is very little chance that any significant modification to their system or their proposed schedule can be affected, except directly through Air Force channels currently managing the MOL project. A synopsis of the current study report being reviewed at this time by the Air Force for final computer approval detailing the basic DIMAC system requirements is discussed in paragraph 2.

The Air Force and Aerospace presently are not wholly in favor of the DIMAC concept "per se." They do recognize and are sympathetic to the need to streamline the checkout and launch of the Titan III C. However, they would prefer that all checkout requirements fit into an integrated checkout approach that as yet has not been defined. The IBM Advanced Systems Group at Los Angeles intends to work very closely with the Air Force and Aerospace in defining and implementing this concept over the next three months. In this regard, the specification prepared for the Martin requirements (not as yet reviewed with Aerospace) has been carefully tailored to integrate with a "unified checkout" concept.

Following a detailed analysis of the Martin requirements, the Advanced Programs Department, Space Systems Center, FSD (Los Angeles), prepared a checkout requirements model, Preliminary Specification for the Design of a Monitor and Diagnostic Computer Complex for the Titan III C Vehicle, dated February 1, 1966.

2. DIMAC System

In general, the report defines the basic system to a point where IBM would initially be capable of proceeding towards defining an effective hardware configuration. As the program develops, however, further engineering liaison will be required with Martin engineering personnel to obtain the additional detailed data pertinent to specifying the final configuration and possible alternates, or interim systems. Specific data is still needed in the areas of data formats, recording requirements, off-line processing requirements, timing, as well as details of estimated system capacity to support pre-launch checkout and the countdown at Vandenberg AFB. Until this data is available, together with estimates of table sizes, data transfer requirement between devices and processes, as well as detailed test requirement specifications, final hardware requirements can only be broadly estimated.

A study of the ILC tradeoff study report Martin-Denver document No. X3-010, submitted by Martin-Denver on 25 October, 1965, assumes that the entire test and operating system program effort will be handled by Martin programmers exclusively. From data available at this time, it is felt the assumption is generally optimistic, since Martin seems to have under-estimated the actual size of a programming effort associated with generating checkout and launch control programs. In all probability, the contractor supplying the hardware itself will have to assume and plan to man some portion of the programming effort, as well as a good deal of the overall system engineering coordination and liaison task, since Martin-Denver is relatively inexperienced in both the programming and the computer aspects of the system engineering involved. The specification, as written, however, indicates that any RFP generated by Martin at this time will be initially for the hardware only. This must, of course, include the associated software package and backup required to allow Martin programming personnel to implement the test and operating system programs. It is felt the completeness of this software package for use by test and system programmers will have a great influence on the final selection of the hardware vendor. It is felt some orientation will have to be given to key personnel at Martin to orient them as to the impact of the programming effort involved in developing a checkout system. Along this line, a visit of Martin engineering to the Saturn project being conducted by IBM at Huntsville, Ala, and Cape Kennedy, Fla. properly handled would give Martin personnel an excellent picture of the actual size of such an effort.

The ILC report discusses the philosophy of system checkout and Martin experience with previous systems to point out and justify the need for this passive concept. The report is divided into four basic areas: a, data handling, b, equipment, c, system operation, d, programming description.

a. Data Handling

The data handling requires the acceptance of up to three PCM data streams each at a rate of 345,600 bits per second and up to four discrete serial data streams, each operating at a rate of 245,000 bits per second. The data will be examined by the DIMAC system on a limit/time corelated basis to determine the performance status of the vehicle under supervision by the system. In the event of deviation from predicted performance, basic diagnostic operations will be brought into action to isolate the cause of the anomaly, or at least indicate possible sources of the problem. Data to the operator will be displayed on a go/no go, criteria basis to the test operators. The system will also provide the operator with reference material in the forms of print-outs and micro-file records of drawings and schematics. Additional output will be provided by the system on an off-line basis for use as launch vehicle qualification records and trouble analysis documentation.

b. Equipment

The general hardware configuration presented by Martin for this application consists essentially of:

A. Three peripheral processors - 1 each to the two PCM streams the third for discrete data from the data recording set (DRS).
B. One main processor controlling the overall system-accepting inputs from the three peripheral processors and pertinent I/O equipment.
C. I/O equipment - line printers, card read-punch, operator consoles and displays, mass storage facilities, plotters, and
D. Special devices. These include in-channel digital comparators, special micro-film file and addressing equipment and special purpose operator consoles and displays (possibly up to six) - (not completely defined in this specification).

c. System Operation

In general, the PCM data stream will be passed from the ground equipment into digital comparators as parallel segments. The data will be compared with data from computer stored tables. All PCM data will be screened in this manner to ensure as complete a coverage of all vehicle systems as is possible. This should enable the system to recognize momentary or transient malfunctions for display to the test operator (when required) and for trend and malfunction analysis purposes. A more complex in-channel comparator must be provided for the Data Recording Set (DRS) data stream to test the discretes from the vehicle. This data will be evaluated on a time and vehicle status basis against pre-defined success criteria stored in the operating system and test programs. DRS changes will be recorded as a printed record and will be passed to the central processor for diagnostic work when required. Selected PCM telemetry data will be transmitted to the Central Processor for trend analysis, for both short and long term histories and predictions. PCM telemetry data will also be transmitted to the Central Processor for diagnostic operations in the event of any deviation from system norms. The diagnostic or malfunction analysis routines in the Central Processor will operate to isolate the cause of the problem to assist and alert test personnel in instituting the desired repairs. The proposed system will be essentially passive in operation, monitoring information channels to assist in system checkout and increase assurance of successful launch performance. As proposed, there will certainly be some operator input to the DIMAC system, but in the initial phases of the effort this input will probably be limited to requests for information by the test operator, modification of limit data, and special system status conditions associated with the actual countdown.

The proposal minimizes not only operator input but also data being displayed to the extent that data displayed to the two-six display consoles is limited to malfunction data and associated information only. It completely excludes status and general information data that might be available within the DIMAC system.

d. Programming Description

The report briefly describes the general programming structure for providing an Operating System Executive type program with the test, malfunction, and trend analysis programs integrated with this Operating System program. The concept, in general, follows very closely the present structure of the Saturn launch control computer programming effort, with the exception that the operating system in this instance will not have active control routines. However, careful design of the passive operating system would allow expansion to an active role, with only a minimum of program modification in the operating system areas.

Presently, the basic requirements of the system defined by Martin include:

1. the ability to perform malfunction analysis to the black box level to allow extremely rapid recovery from a hold during checkout or launch activities.
2. the ability to provide real-time go/no go success criteria comparisons as derived from the data recording set (DRS) and telemetry instrumentation data of the launch vehicle, including guidance functions for checkout, combined system tests and launch activities.
3. The ability to analyze trends for possible detection of malfunctions before actual occurrence and for specific malfunction analysis during checkout and launch activities.
4. The ability to provide highly applicable displays (in engineering units), and on-line tabulation of discrete event changes.
5. The ability to appreciably reduce instrumentation systems checkout time while concurrently improving the accuracy of associated calibration techniques.

In summary, the study report was concerned with implementing a means of automatic reduction and analysis of data, emanating from the launch vehicle and ground equipment. It attempted to define hardware configurations from each of several capability levels and recommended an "optimized" configuration to satisfy VAFB requirements. The study outlined a) the requirements for and capability of the system at several descriptive task levels. b) a block diagram description of the system with general requirements and functions of each block with gross data flow within the system indicated. c) an initial analysis of the impact of the data integration malfunction analysis computer (DIMAC) upon the various phases of the ILC program for design through launch. d) the summary and recommendations.

The report is currently in possession of the IBM MOL Project Group and is available for review and analysis, as required.

There is presently little doubt that internal constraints within Martin will prevent delivery of the final DIMAC system much earlier than July, 1967.

It is apparent that Martin-Denver engineering personnel are anxious to have IBM assist them in this effort and are most favorably impressed at this time with IBM's ability to satisfy their engineering requirements. This cooperation has been further enhanced by the ETR effort, which has given IBM a legitimate reason for being in close engineering contact with Martin-Denver personnel. In this regard, a series of meetings and working sessions with IBM and Martin engineering have been accomplished on almost a daily basis for the last three months. The working relationship has placed IBM in a very preferential position within the Martin structure since the work currently in progress in Denver associated with the ETR study is closely related to the eventual DIMAC concept and the daily information exchange has given IBM a much better view of the engineering details of DIMAC than other competitors currently interested in the system. This data has and will allow a good deal of advance planning and specific engineering design geared to the preparation of a proposal to meet any eventual RFP.
If this time advantage can be utilized in the near future, it will allow a thorough definition and configuration of a system to satisfy the DIMAC requirements, not only from the standpoint of the present system hardware concept, but also from the standpoint of any alternate configurations in the event the price and delivery would preclude a proposal based on the prime configuration alone.

3. IBM OCALA Study Effort at KSC

The Eastern Test Range effort currently being supported by Aerospace, Martin and the Air Force, and implemented from the equipment and programming standpoint by IBM at Cape Kennedy, is being carried on to gain experience in the use of an on-line digital computer for data analysis during system tests and the actual launch countdown of a particular launch vehicle; in this case, the Titan.

These tests are planned to establish guide lines for developing a firmer system concept, hardware design, computer programming requirements, manpower and cost requirements, as well as feasibility data for an operational system of this nature to be located at the Eastern Test Range at a later date, as well as a test bed for determining the feasibility and any pertinent problems that would be applicable to the Martin proposed DIMAC system. The project titled "On-Line Computer Analysis and Launch Assistance (OCALA)" is being managed by SSD/Aerospace with Martin-Denver serving as integrators for all efforts pertaining to the study definition implementation, installation, and the final study report to be provided at completion of the program. IBM, KSC, is presently providing the computer system, programming assistance and guidance, computer maintenance, as well as pertinent system analysis and feasibility engineering. Martin-Denver is providing the special hardware (in-channel comparators) together with interface adapters (as well as some 7044 computer time). Martin-Denver retains configuration control at this time for all software and hardware.

A 7044 computer is being provided by IBM for connection to the existing Titan III ground support equipment to conduct feasibility tests. IBM is presently implementing the monitor executive program, derived from the existing SPADATS monitor program developed by IBM at Eglin AFB. This monitor program is being developed to sequence task execution according to time, events and operator inputs. This program was checked out at the University of Miami in late December, 1965. The on-line connections to associated Titan GSE will now be made and operational tests conducted. Operating experience will be evaluated in terms of original system design criteria. At this time it is planned to support two Titan launches with this system in operation.

Under present plans, the ground support instrumentation role of the VIB at KSC will provide access to all of the required signals for system test evaluation on Project OCALA. The IBM 7044 data processing system will be tied into the GSE with a minimum of interference, with concurrent use of existing ground equipment. The proposed configuration for the study includes a 1301 disk storage unit, two 729 V magnetic tape units, a 600 line per minute 1403 printer and a 1402 card read/punch unit. A physical installation plan has been determined, approved, and is in the process of implementation. Data from the PCM links will be obtained from the Data Storage Registers in the Astro-Data ground station in the instrumentation room. Eight bit syllables will be transferred as they are assembled in the DSR to a variable character input (VCIS) sub-channel adapter in the IBM 7288. The function of this sub-channel will be to provide controls in data buffering to assemble four syllables from the telemetry link into one 36 bit computer word. The sub-channel will gate the entire 950 syllables from a major frame into a block of computer storage starting with the first syllable after the main frame sync pulse is received. A similar approach for the data recording set 7 bit character is also being implemented to feed this output into the 7044.

As planned, the computer will maintain a current table of data limits in core storage for all PCM syllables. These limits will be transferred to a hardware comparator in the PCM interface equipment through a variable character output sub-channel (VCOS). Each syllable will be compared against the high and low limits as it is transmitted to the VCIS. If it is outside the set limits, a bit will be placed in the 9th position of the syllable storage location. An out of limits interrupt will also be signalled to the VCOS. The output limit data and input data stream will be synchronized by means of the main frame sync pulse at this time.

Current participation as of January 18, 1966, is as follows:

IBM

1 Project Manager
2 Systems Engineers
1 Programmer
1 Programmer*

Martin

2 Systems Analysts*
1 Systems Analyst (Martin-Denver)
1 Systems Analyst (Martin-Canaveral)
3 Programmers
1 DIMAC Engineer Supervisor

Aerospace

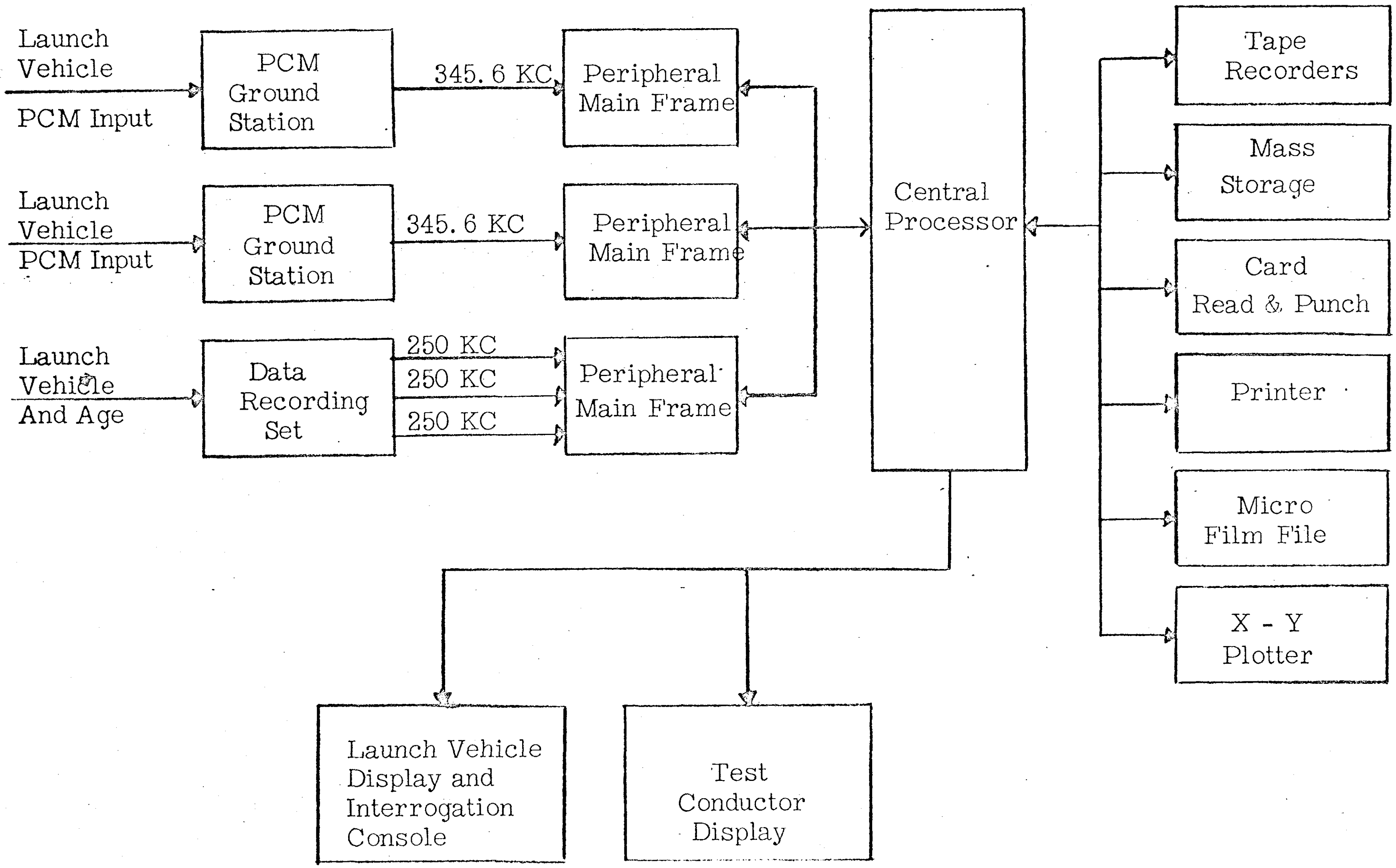
2 Programmers

* Part time

BLOCK DIAGRAM PROPOSED DIMAC SYSTEM CONFIGURATION

MARTIN ILC REPORT 5 OCT. 1965

IBM CONFIDENTIAL



D. PROBLEM AREAS

Unresolved elements requiring further effort and careful analysis by IBM cover the full spectrum of problems normal to providing this type of a system to the Aerospace Industry during the inceptive phases of the large Aerospace efforts such as MOL. These general problems include:

1. Ability to deliver the required equipment within the proposed schedule constraints (the most serious IBM constraint at this time).

2. Ability to completely, competitively price the required system (IBM is very competitive if the complete package is considered and effectively presented to Martin).

3. Requirement of defining in detail actual system requirements and the optimum configuration of the DIMAC system for present and future applications. Reference the Preliminary Specification for the Design of a Monitor and Diagnostic Computer Complex for the Titan III C Vehicle dated February 1, 1966.

4. Requirement for careful additional analysis of impact of the Eastern Test Range study effort (being conducted by IBM) on the DIMAC system configuration, as well as the overall IBM aerospace effort.

With regard to delivery problems, data available at this time clearly indicates a high probability that the system as presently configured may require up to three 1800 systems, as well as a 360/44 configuration to be delivered by July, 1967. However, this particular problem as well as the competitive pricing problem cannot be fully resolved until a more adequate definition of the optimum system configuration has been provided, and further data on the MOL Project Office reaction to the system proposed by Martin has been obtained.

E. IBM STRATEGY

E.1 Sales Action Program

Presently, effort is centered at Denver and KSC and involves the establishment of close communication and engineering liaison with Martin personnel at Denver and KSC who are responsible for both the DIMAC system design and final evaluation of the ETR study. It is planned to expand this effort to the point where Martin-Denver is thoroughly familiar with all unique features and advantages of IBM equipment suggested for DIMAC and are fully aware of IBM experience in related areas of launch checkout and control operations.

A pre-proposal effort has been initiated to perform a thorough system analysis from the hardware and software viewpoint of the DIMAC problem. The output of this study will be the definition of an optimized IBM system configuration. This task was completed on January 25, 1966. The results of this pre-proposal effort will be reviewed by various IBM facilities either responsible for development and delivery of the proposed hardware and software, or who have personnel experienced in this type of a system application. The first such conference is scheduled at the San Jose Plant, Special Engineering, on February 15, 1966, and is the first coordination effort following completion of the February 1 Preliminary Specification. Huntsville, Cape Kennedy and Denver will be visited during the week of Feb. 28 - Mar. 4, 1966. Additional coordination will be effected with the Engineering Lab, Bethesda and Special Engineering (Poughkeepsie). The results of these reviews will be incorporated into the final document for use as the basis of any proposal generated by IBM in response to an RFP for the DIMAC system.

At present, the West Coast aerospace MOL group is supporting the proposal and maintaining close liaison with Martin-Denver, Aerospace Corporation, and the Cape Kennedy OCALA study. At this time, initial contact has been established with cognizant personnel associated with the ETR effort and the DIMAC effort and meetings have been set up for general discussions and common exchange of data regarding the overall problem.

Since the East Coast study is directly related to the DIMAC effort and its output and results will largely determine the course of the DIMAC system, every effort is being made by the IBM MOL Project Group to insure that the ETR study is adequately supported and that proposed schedules are realistic. Close engineering monitoring of the progress of this effort will be continued through June of 1966 to insure maximum utilization of output of this study is made by IBM for eventual incorporation into the DIMAC effort.

E.2 Technical Help Required

A qualified technical engineering team is required to implement the planned pre-proposal system study and to review and comment on the study results This team is now being assembled under the engineering direction of the IBM West Coast MOL Group.

E.3 IBM System Design

No formal system design has been completed at this time. A preliminary system configuration utilizing a 360 Model 44 and three IBM 1800's has been tentatively proposed to Martin personnel. Engineering analysis now being performed on this proposal, however, indicates there may be some deficiencies in implementing this type of a system, both from the standpoint of capability of performing the task presently defined, as well as ability to expand to what is felt will be future requirements if the DIMAC system proves satisfactory. The Preliminary Specification analysis was completed January 25, 1966. The document itself is dated February 1, 1966. There is a high probability that the proposed system configuration resulting from the system study will utilize an IBM 360 Model 44 as the central processing element.

The Engineering Lab (Bethesda) is currently evaluating the initial technical approaches and expects to conclude this effort by March 15, 1966. Comments to be forwarded to Advanced Programs (Los Angeles) will include an engineering critique, recommendations, and ballpark price estimates. Special Engineering (Poughkeepsie) is currently examining design requirements for a special high speed data acquisition channel somewhat similar to the 2909 but with in-channel comparators. Their study is expected to conclude on March 1, 1966.

F. SCHEDULE OF KEY TARGET DATES

Since the DIMAC and the OCALA efforts are closely interrelated, there are in this case two complete sets of target dates; one associated with the development of the DIMAC system, and the other related to the development and outcome of the OCALA effort at Cape Kennedy.

DIMAC Target Dates

1. Martin tradeoff study forwarded to Air Force - October 5, 1965
2. Completed IBM pre-proposal effort for DIMAC - January 25, 1966.
3. Contemplated Air Force concept approval - end of May, 1966.
4. Release of RFP for DIMAC - early July , 1966.
5. Date for reply to RFP - mid-August, 1966.
6. DIMAC contract award - early September, 1966.
7. Initial equipment installation at Denver - mid-July, 1967.
8. Equipment installation at VAFB - early November, 1967.

IBM OCALA Effort at Cape Kennedy

1. Initial proposal for study by IBM - late August, 1965.
2. Air Force approval of OCALA study effort - November, 1965.
3. Computer system installed at Cape Kennedy - February, 1966.
4. Checkout and debugging of monitor and applications programs - March, 1966.
5. Use of OCALA system in support of Titan launch - May, 1966.
6. Use of OCALA equipment in support of second Titan launch at Cape Kennedy - July, 1966.
7. IBM portion of study effort completed - July, 1966.
8. Results of OCALA study effort published - July/August, 1966.

G. COMPETITION

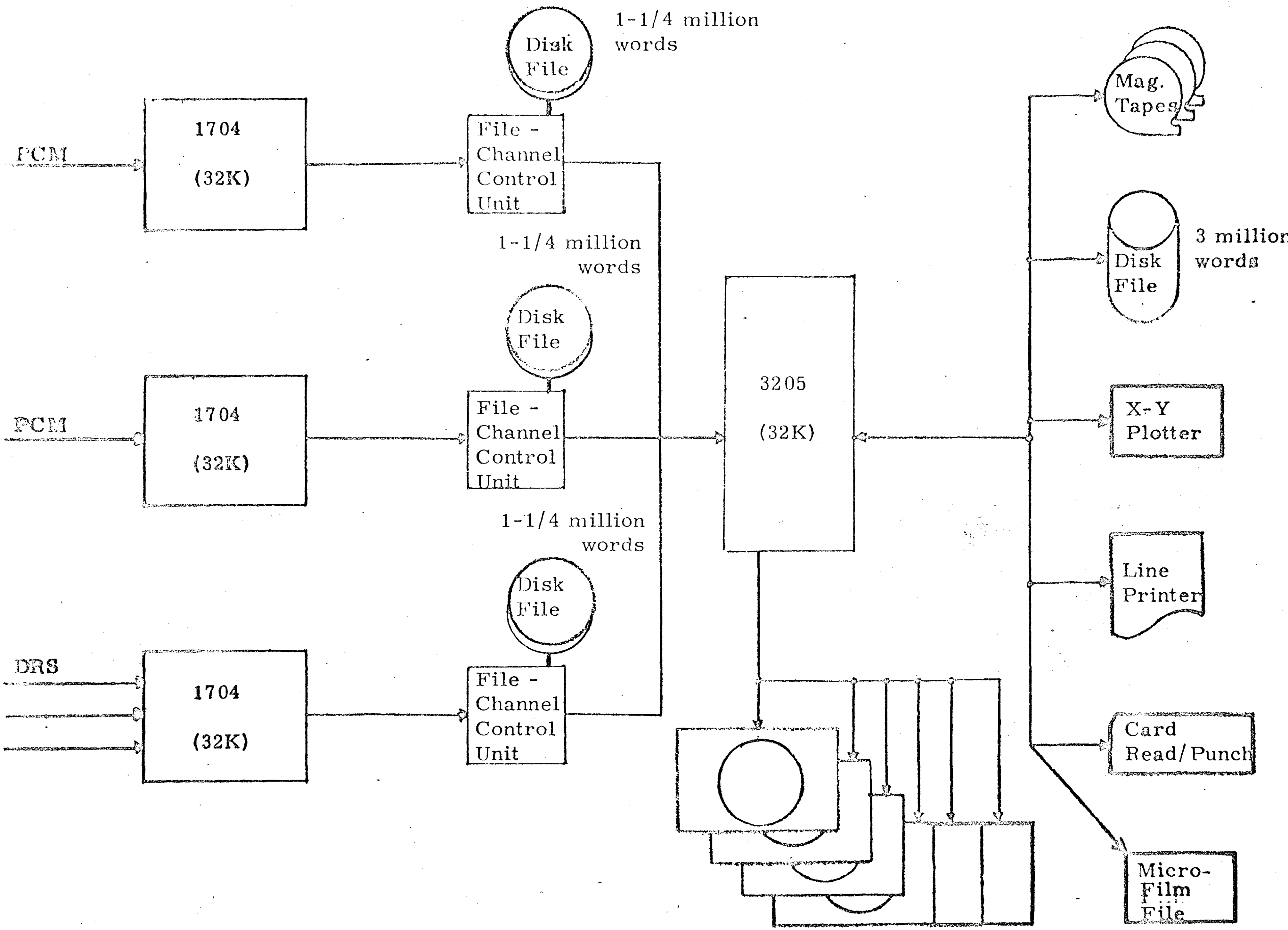
It is fairly certain that active competition in this area will include the Digital Equipment Corporation and Control Data Corporation, with a high probability that General Electric will also bid on any RFP. While there will probably be others who will receive the RFP when generated, it is not expected (at this time) that there will be other significant competition due to the complex system analysis requirement in the short estimated response time associated with the RFP from Martin.

At present, the other active competitors, on an equivalent engineering status with IBM, include the Digital Equipment Corporation and Control Data Corporation. They both have been actively involved in the systems design of the DIMAC, but to a much lesser extent up to now than IBM has. Both have submitted a preliminary configuration for review by Martin who in some cases have commented on their proposal to IBM personnel. In this regard, one strong point for the DEC configuration is a proposed memory sharing approach which DEC feels would minimize inter-system data transfer and would eliminate some timing problems. A weak point in the opinion of Martin in the overall approach of DEC to this problem is felt to be in the area of programming and equipment support DEC would plan to provide. Martin engineering seems to feel that they would not have enough programming and equipment support from the standpoint of equipment integration, software packages, programming assistance, and programmer and test engineering training. In this regard, Martin has stated that competent system support in these as well as the actual vehicle checkout areas is considered critical to success of the DIMAC system.

RCA submitted a comprehensive analysis of the DIMAC concept late in December. During the presentation, they expressed a desire to be an active part of this system. They have assigned an engineering team to actively monitor system progress. Brief looks at RCA document showed it to be well prepared and in consonance with Martin philosophy.

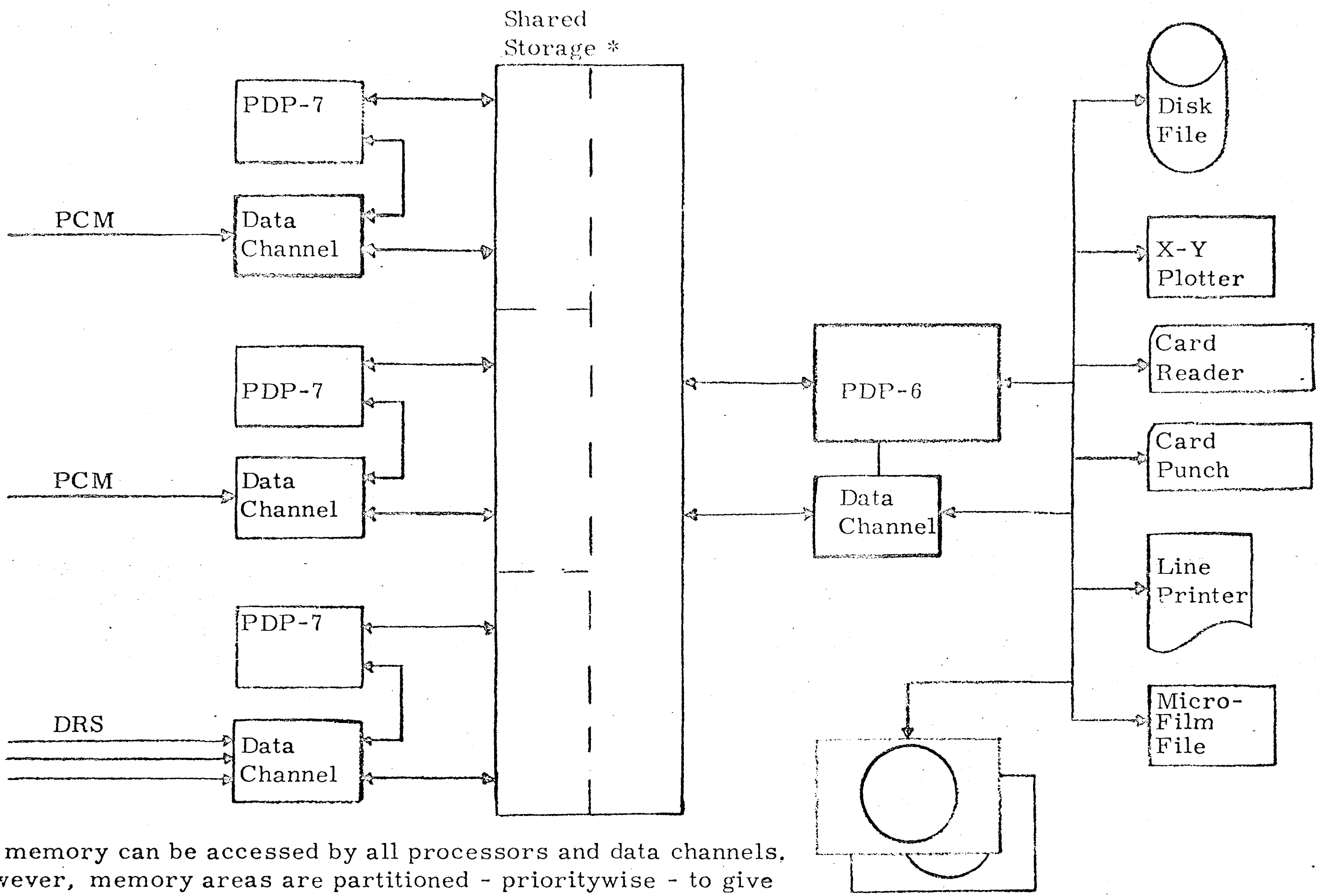
BEST ESTIMATE OF CDC CONFIGURATION

Estimated System Cost $1,000,000



BEST ESTIMATES OF D. E. C.'s CONFIGURATION (**)

Price estimated to be somewhat less than IBM 1800-360/44 configuration



Operator Displays (The number of devices is not known at this time)

* All memory can be accessed by all processors and data channels. However, memory areas are partitioned - prioritywise - to give a particular processor primary control over a specified area of memory.

** The details of this configuration are superficial so that operations of the shared memory and PDP I/O channels is questionable.

H. CORRESPONDENCE AND ACTION RECORDS

Due to the large amount of correspondence in the DIMAC area, only a small portion of what is felt to be significant correspondence in this area has been included at this time.

The following is a listing of additional correspondence available at the MOL Project Group central file related to both the DIMAC and the Cape Kennedy OCALA effort. Copies may be obtained either by formal letter request to:

IBM MOL Project Office
Advanced Programs (SSC)
Federal Systems Division
9045 Lincoln Blvd., Los Angeles 90045

or by telephone request to:

213 670-8350 Ext. 652

1. DIMAC computer support requirements - Martin-Denver, Nov. 5, 1965.

2. Assumed functions of DIMAC system from programming standpoint - R. Mossman, IBM, December 10, 1965.

3. Trip Report regarding Martin-Denver checkout concept covering periods December 8 through 10, 1965 - G. Boruski, IBM/LA.

4. Trip Report - MOL checkout system for Martin-Denver - Oct. 11, 1965 - W. Peavy, Washington Systems Center.

5. OCALA study monitor program descriptive specification - Nov. 5, 1965, R. Blue/L. Perkins, IBM, Cape Kennedy.

6. OCALA monitor notes - J. Hoerning - December 1, 1965.

7. Conference notes on ETR computer study review held at Martin-Denver November 1, 1965.

8. Weekly project OCALA status reports - Nov. 5 through Dec. 10, 1965, R. E. Blue, IBM/Cape Kennedy.

9. Preliminary System Specification for the Design of a Monitor and Diagnostic Computer Complex for the Titan III C Vehicle, Feb. 1, 1966.

IBM COMPANY CONFIDENTIAL

October 6, 1965

TO: Mr. R. Winckler
DENVER

FROM: Mr. F. X. O'Rourke
FSD
HUNTSVILLE, ALABAMA

SUBJECT: Comments on IBM-Martin Computer Implementation Concept for MOL Checkout

1. General

As a result of agreements between Mr. T. Welch of WSC and Mr. J. Meadlock of IBM-FSD, Huntsville on September 29, 1965, the writer was assigned to evaluate and comment on existing details of the proposed IBM computer implementation concept satisfying postulated Martin-Denver requirements for MOL checkout and launch control functions.

During this visit the writer discussed the problem with Mr. R. Winckler of IBM, Marketing Representative; Mr. J. Stunkel, Systems Engineer; Mr. Robert Umbreit, Marketing Manager; as well as Mr. Kent Gunderson, Mr. Rod Ourada and Mr. Bryan Pennington, all of Martin-Denver.

As a result of these conferences and by reviewing preliminary configuration documentation (provided by Mr. Winckler), some basic conclusions were reached regarding the nature of the Martin requirements as proposed by Mr. K. Gunderson.

It should be stressed that due to the short duration of the visit, these conclusions are preliminary and are noted here to provide a basic structure within which further system study may be initiated.

2. Proposed Equipment Configuration

Martin presently envisions a computer system to perform advisory and monitor functions only. The system requirement described by Martin personnel would not be a part of the countdown or launch control loop and would have no capacity to generate stimuli to the vehicle being launched or checked out through the computer system.

Their engineering view of the system includes a computer complex capable of monitoring telemetry data from both the vehicle and associated ground system as well as specific vehicle discretes. The proposed system would, through hardware and program control, perform limit comparisons on the telemetry data, and when out of tolerance conditions affecting the ability to launch the vehicle occur, suitably process this information and transmit it to appropriate display consoles. The system, as configured, would have the capacity of monitoring from 400 to 3,000 analog quantities input to the computer configuration from T/M ground stations and discrete output equipment associated with the vehicle.

There would be up to three display consoles in the proposed system, one console would be of a "Test Conductor Monitor" variety over which specific fault messages with little or no troubleshooting data would be displayed. The other consoles would be of the test engineering (Trouble-shooting) variety which would display not only the fault but pertinent trouble-shooting and diagnostic data to allow further evaluation of the fault by the Test Engineers.

Both "troubleshooting" consoles, as proposed, would have keyboard input facilities to the computer to allow recovery of certain specific parameter information held in computer core. The system further envisions the use of standard peripheral equipment found in existing launch control systems including printers, graph display facilities, disk files, card read and punch facilities and tape recorders. A somewhat unique item of peripheral equipment proposed would be an IBM Microfilm File. In the application suggested, the central processor (IBM System/360) would not only display pertinent information to the three consoles upon malfunction detection but would also call up (under program control) microfilm file data related to the malfunction to provide maintenance personnel with pertinent troubleshooting data to assist in formulating remedial actions. This microfilm data could not only be called up under direct program control as determined by the error but could also be requested by the operator to supplement his initial data.

Enclosure I of this document illustrates the general block level configuration of the proposed system which uses up to four 1800's feeding a master control processor implemented with a 360/44 system.

Martin-Denver personnel stressed that a basic ground rule of this system would be THAT NO ELEMENT OF THIS MONITOR AND DISPLAY SYSTEM WOULD EVER BE CONSIDERED LAUNCH CRITICAL. In this regard, no functions performed by this system would be of such a nature that their loss or omission would in any way hinder the launching of a vehicle.

As proposed by Martin, the DIMAC system (Data Integration and Malfunction Analysis Computer) configuration is planned for utilization by all contractors to enhance the probability of "launch on time", "mission success", and "crew safety". The DIMAC system is envisioned by Martin as a powerful and flexible device capable of satisfying the individual contractor's computer requirements for simultaneous or individual usage.

In summary, Martin assumes the system will be capable of isolating malfunctions, providing data computations, comparing actual limits and events versus theoretical pre-defined limits and events on a continuous CONSTANTLY UPDATED BASIS using both event and time criteria to update the limit evaluations. Enclosure I of this document further summarizes general requirements of the system as postulated by Martin.

3. Conclusions and Comments

From the data available to the writer from both Martin and IBM-Denver, the approach as postulated by K. Gunderson is very feasible and very conservative. It represents the state of Douglas checkout approximately two years ago and, if implemented correctly, could be of material assistance in streamlining launch countdown troubleshooting as well as vehicle checkout and validation tasks prior to the actual countdown. This system if developed would provide the launch complex with a readily accessible troubleshooting data source as well as a comprehensive, partially continuous monitor capability during both checkout and launch functions of the Titan vehicle.

In this regard it is the writer's opinion that IBM should exercise great care in assuring that cognizant Martin and Air Force personnel are thoroughly aware of the basic constraints of the proposed computer configuration and that any expansion of the proposed system to include a capability of generating stimuli to the vehicle or acting in the direct launch countdown control loop would require significant modification of the overall system from both the hardware and programming standpoints.

It is the writer's impression that personnel at Martin who were contacted in this effort were knowledgeable and fully aware of the ramifications of their proposal. However, it is felt that prior to further investigation IBM should ascertain the feeling of Martin management to the eventual implementation of this proposal and,if at all possible, the feelings of the Air Force in this regard.

The concept, however, if developed affords an excellent entry for IBM into the checkout and control business associated with the Aerospace Industry. It would allow IBM to enter into the design and development of an Aerospace computer system that is external to the main control link of the vehicle. In this way IBM can gain very significant experience in the Aerospace Engineering problem without being immediately subjected to a critical spotlight in the event the system runs into unforeseen difficulties. IBM can then utilize this experience to expand its computer systems efforts into supplying hardware systems directly in series with the launch control links associated with firing and checking out a vehicle based on capability acquired in producing the Martin system. In the event that IBM as a Company desires to get a foothold in the Aerospace Industry for the next ten years, this type of system affords an excellent opportunity to do just that.

In summary, the following list of comments and conclusions is presented for evaluation and consideration.

1. The system being proposed by Martin-Denver is conservative and very feasible.

2. The implementation configuration using 1800's working in conjunction with the 360/44 System seems feasible but requires a good deal more of detailed engineering study to provide engineering assurance that the many details associated with data rate, comparison requirements, addressing requirements, special hardware, system interface, and expansion potential will not constrain the development of this system in such a way that the basic requirements of Martin could not be adequately satisfied.

3. Due to the departure of this approach from the general approach presently recommended by Douglas and NASA, IBM must assure itself before going any farther that Martin management and Air Force personnel have approved the basic approach and thoroughly understand the postulated ground rules of this type of a system.

4. After this assessment has been made it is strongly recommended that a Systems Engineering team comprised of qualified engineering and programming personnel from Huntsville and WSC form a system study team at Denver in conjunction with Systems Engineers thoroughly familiar with the elements of the 1800 and 360 Systems. This group would study the proposed configuration from all aspects and in essence, define interface details associated with the computer configuration IBM should propose to Martin.

5. Upon completion of this study and the associated documentation, the results should be carefully reviewed by design review teams at Huntsville, WSC and Denver. After this, a final proposed configuration should be drawn up and presented to cognizant Martin personnel for their opinion.

6. It is apparent from comments made by personnel at Martin that they are not fully aware at this time of the size of the programming task they have undertaken. It is recommended that IBM discreetly and cautiously through Martin management increase their awareness of the programming task associated with implementing a system of this type. In this regard, it is felt it would be very beneficial for selected Martin personnel to visit Huntsville for a day or two to go over specific engineering details associated with implementing the proposed computer configuration. This should not be undertaken until IBM's approach and desires for this type of business have been thoroughly established and the general goals of the group defined.

7. In the event this effort is implemented and IBM does provide 360 and 1800's to Martin, it will be mandatory that IBM also provide a high level of associated Systems Engineering support. Martin seems fairly weak in overall engineering experience associated with digital computer implementation techniques, as well as the more complex and sophisticated programming requirements which must be considered when installing a system of this nature.

8. In the event this study does develop and data becomes available that indicates this should be a significant IBM effort, immediate steps should be taken to consolidate its development into one coordinated effort as soon as possible, inasmuch as dual efforts, no matter how small or well directed (i.e., R. Blue's effort with field personnel at KSC), can pose serious problems of coordination and can effectively retard the overall progress of a complex effort of this nature by presenting IBM as two separate groups within one company.

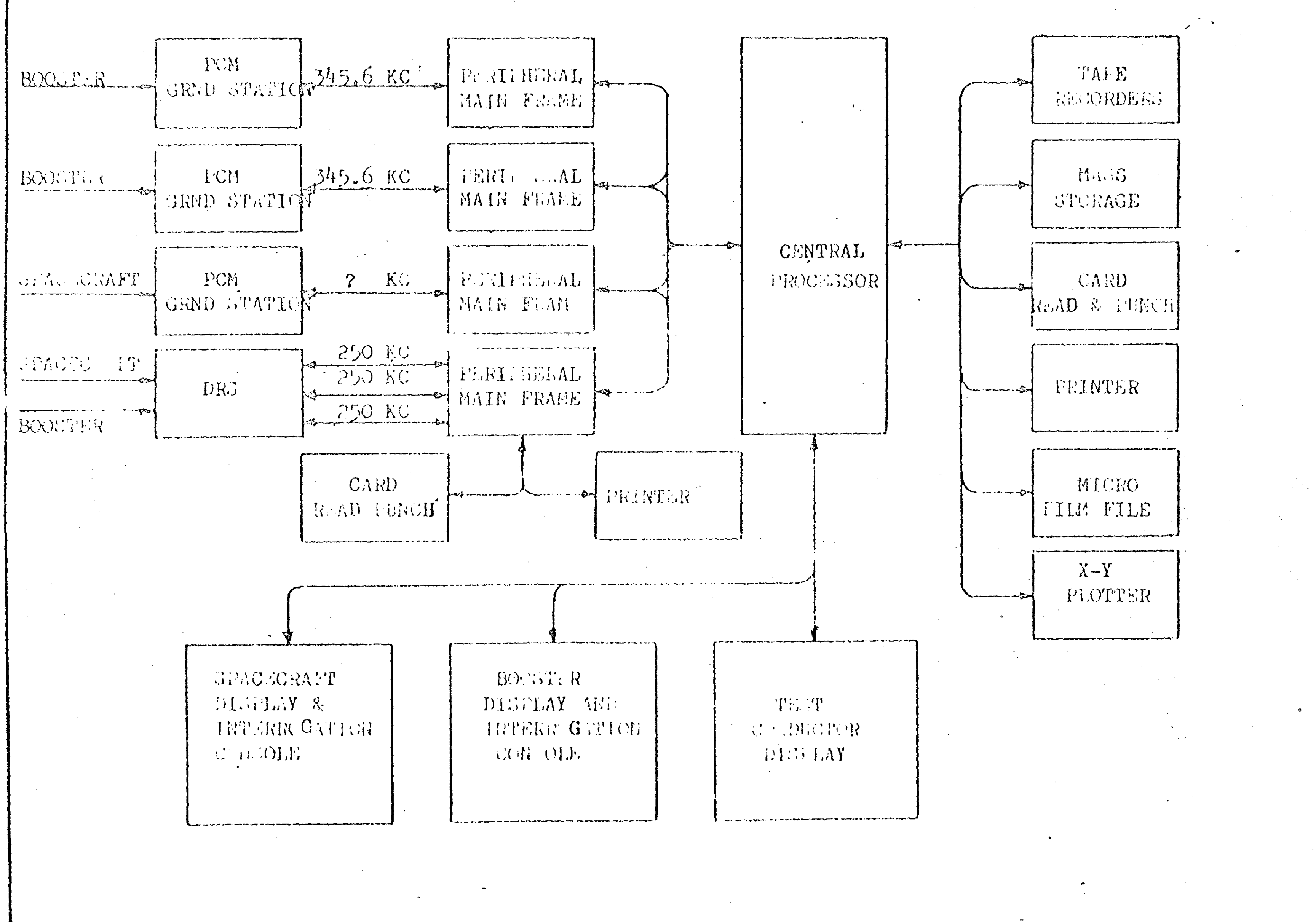
9. Prior to effecting any formal commitment, IBM must thoroughly investigate its ability to produce the required system <u>on time</u> and should carefully consider the requirements placed on the present production capability by this system in relation to existing IBM delivery commitments <u>especially in the area of "1800" units.</u>

FXO 10-7-65

F. X. O'Rourke

FXO:ht
cc: J. Meadlock-IBM-Huntsville
W. Peavy-IBM-WSC
T. Welch-IBM-WSC

DATA INTEGRATION AND MALFUNCTION ANALYSIS COMPUTER (DIMAC)



For ILC operations a MMC provided, common service computer (DIMAC) will be utilized by all contractors to enhance the probabilities of "LAUNCH ON TIME", "MISSION SUCCESS," and "CREW SAFETY". DIMAC will be an extremely powerful and flexible device, and will be capable of satisfying each individual contractors computer requirements on a simultaneous or individual useage.

The DIMAC will utilize telemetry (PCM), and DISCRETE (DRS) data as its inputs, and will be capable of isolating malfunctions, providing data computations, comparing actual limits and events vs theoretical pre-defined limits and events on a continuous basis, and providing appropriate displays to individual contractors. (An assumption is made by MMC that the individual contractors input data will contain the information which is necessary for the computer to provide these capabilities.)

The following is a list of general and individual system requirements for the booster vehicle, and is included as an example of the tasks that MMC will accomplish with DIMAC. A comparison matrix is included also, as an example of the total control center OGE task vs capability.

General Requirements

1. Malfunction analysis and isolation to the black box level for all systems.

2. Success criteria comparison in real time for subsystem checks, CST and launch countdowns.

3. Trend analysis of appropriate data on a vehicle/vehicle, test/test or short term basis.

4. Provide DRS on line tabulation of all discrete event changes.

Requirements per System

1. Flight Controls

   A. Provide redundant and extended monitor capability for VECOS checks.

   B. Provide capability for end to end testing of the attitude control system.

   C. Provide parallel monitoring of redundant systems.

D. Provide trend data for following items:

(1) Actuator response and positioning
(2) Hydraulic pressure, level, and temp
(3) Gyro tem/time
(4) Gyro spin up and spin down time
(5) Gyro output versus torquing stimulus

E. Monitor pump motor total starts, and the total run time.

F. Evaluation guidancepackage performance.

G. Monitor guidance input and offsets to the autopilot.

2. Tracking and Flight Safety

A. Monitor battery on line time.

B. Monitor SOCVU operate time.

C. Plot AGC voltage versus time.

D. Monitor all bus voltages.

E. Provide trend data for following items:

(1) Battery current/time profiles
(2) All SOCVU and switch operate times
(3) S & A operate times
(4) AGC voltage

3. Propulsion

   A. Compute actual load during propellant loading by correlating level sensor, flow meter, tank calibration, pressure, and temperature data.

   B. Provide tank pressure, and temperature readouts in engineering units.

   C. Monitor and provide calculations on propellant tank temperature.

   D. Expedite checkout of transtage helium, nitrogen, and attitude control system.

   E. Provide trend data on following items:

      (1) Tank pressure and temp
      (2) Valve and pre-valve time and position
      (3) Start cartridge temperature

4. Electrical

   A. Monitor all bus and battery voltages.

   B. Monitor battery on line time.

   C. Provide trend data on following items:

      (1) Battery current/time profiles
      (2) All switch and relay operate times.

5 Instrumentation

   A. Provide automatic correction of calibration data.

   B. Provide data and displays in engineering units.

   C. Provide limits checks on all PCM data as a function of time and event.

D. Provide automatic or on demand ambient checks and print out.

E. Plot system calibration plots and print outs.

F. Provide computational capability for reducing data.

As a result of having the computer, the following additional capabilities will be available.

1. In flight monitoring and computational capability.

2. Post flight and post test data reduction and analysis.

3. Complete system status (vehicle, GOE, and GIE) at any time.

4. Administrative services such as

   A. Procedure status and procedure writing

   B. Test scheduling and monitoring

   C. PERT critical path monitoring

   D. Reliability success/attempts monitoring and tabulation

   E. Configuration control

   F. Spares status

   G. Tabulate support requirements for all tests

   H. Rework and retest estimates

   I. Open items status and control

5.

IBM 066232 (11-62)

TASK VERSUS EQUIPMENT CAPABILITY MATRIX

	MALFUNCTION ANALYSIS - BOOSTER	MALFUNCTION ANALYSIS - SPACECRAFT	TREND ANALYSIS - BOOSTER	TREND ANALYSIS - SPACECRAFT	SUCCESS CRIT COMP - BOOSTER	SUCCESS CRIT COMP - SPACECRAFT	PCM LIMITS COMP - BOOSTER	PCM LIMITS COMP - SPACECRAFT	PCM AMBIENT TAB - BOOSTER	PCM AMBIENT TAB - SPACECRAFT	EVENT CHG TAB - BOOSTER	EVENT CHG TAB - SPACECRAFT	PLOT PCM CALIBRATION CURVES	PROVIDE DISPLAYS IN ENG. UNITS	TOTALIZE (PUMP, SWITCH) OPER. CYCLES	PROVIDE COMPUTATIONAL CAPABILITY *	AUTO COMPENSATION OF PCM ERRORS	PROVIDE CONTINUOUS OGE GIE VEH STATUS	RELIABILITY SUCCESS/ATTEMPTS TABULATION	PROVIDE PERMANENT RECORD OF ERROR DATA	PROVIDE INDIVIDUAL DISPLAYS FOR ALL ASSOC	PROVIDE AUTO TABULATION OF HOLD TIME
MMC GIE DISPLAYS	M	M	M	M			M	M	X	X								L	M	M	L	
REMOTE DAS PRINTERS	M	M	M	M	M	M									M			M	M	M	M	M
REMOTE TECOS	L		M		L						X	X										
CONTROL CENT. DISPLAYS	L	L																L				
COMPOSITE OF ABOVE EQ.	⊗	⊗	⊗	⊗	⊗		M	M	X	X	X	X			M			⊗	M	⊗	⊗	
DIMAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

* FOR PROPELLANT LOAD AND TEMP FOR DATA REDUCTION

X = COMPLETE AUTO CAPABILITY
= NO CAPABILITY
L = LIMITED AUTO CAPABILITY
M = MANUAL CAPABILITY
⊗ = COMPLETE CAPABILITY BY LIMITED AUTOMATIC AND MANUAL MEANS

66232 (11-62)

TASK VERSUS EQUIPMENT CAPABILITY MATRIX

	MALFUNCTION ANALYSIS - BOOSTER	MALFUNCTION ANALYSIS - SPACECRAFT	TREND ANALYSIS - BOOSTER	TREND ANALYSIS - SPACECRAFT	SUCCESS CRIT COMP - BOOSTER	SUCCESS CRIT COMP - SPACECRAFT	PCM LIMITS COMP - BOOSTER	PCM LIMITS COMP - SPACECRAFT	PCM AMBIENT TAB - BOOSTER	PCM AMBIENT TAB - SPACECRAFT	EVENT CHG TAB - BOOSTER	EVENT CHG TAB - SPACECRAFT	PLOT PCM CALIBRATION CURVES	PROVIDE DISPLAYS IN ENG UNITS	TOTALIZE (PUMP, SWITCH) OPER CYCLES	PROVIDE COMPUTATIONAL CAPABILITY *	AUTO COMPENSATION OF PCM ERRORS	PROVIDE CONTINUOUS OGE, GIE, VEH STATUS	RELIABILITY SUCCESS/ATTEMPTS TABULATION	PROVIDE PERMANENT RECORD OF ERROR DATA	PROVIDE INDIVIDUAL DISPLAYS FOR ALL ASSOC	PROVIDE AUTO TABULATION OF HOLD TIME
..C GIE DISPLAYS	M	M	M	M			M	M	X	X				L				L	M	M	L	
..TE DAS PRINTERS	M	M	M	M	M	M									M			M	M	M	M	M
..TE VECOS	L		M		L						X	X										
..ROL CENT. DISPLAYS	L	L																L				
..OSITE OF ABOVE EQ.	⊗	⊗	⊗	⊗	⊗	M	M	M	X	X	X	X		L	M			⊗	M	⊗	⊗	
MAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

* FOR PROPELLANT LOAD AND TEMP FOR DATA REDUCTION

X = COMPLETE AUTO CAPABILITY
  = NO CAPABILITY
L = LIMITED AUTO CAPABILITY
M = MANUAL CAPABILITY
⊗ = COMPLETE CAPABILITY BY LIMITED AUTOMATIC AND MANUAL MEANS

For ILC operations a MMC provided, common service computer (DIMAC) will be utilized by all contractors to enhance the probabilities of "LAUNCH ON TIME", "MISSION SUCCESS," and "CREW SAFETY". DIMAC will be an extremely powerful and flexible device, and will be capable of satisfying each individual contractors computer requirements on a simultaneous or individual useage.

The DIMAC will utilize telemetry (PCM), and DISCRETE (DRS) data as its inputs, and will be capable of isolating malfunctions, providing data computations, comparing actual limits and events vs theoretical pre-defined limits and events on a continuous basis, and providing appropriate displays to individual contractors. (An assumption is made by MMC that the individual contractors input data will contain the information which is necessary for the computer to provide these capabilities.)

The following is a list of general and individual system requirements for the booster vehicle, and is included as an example of the tasks that MMC will accomplish with DIMAC. A comparison matrix is included also, as an example of the total control center OGE task vs capability.

General Requirements

1. Malfunction analysis and isolation to the black box level for all systems.

2. Success criteria comparison in real time for subsystem checks, CST and launch countdowns.

3. Trend analysis of appropriate data on a vehicle/vehicle, test/test or short term basis.

4. Provide DRS on line tabulation of all discrete event changes.

Requirements per System

1. Flight Controls

   A. Provide redundant and extended monitor capability for VECOS checks.

   B. Provide capability for end to end testing of the attitude control system.

   C. Provide parallel monitoring of redundant systems.

D. Provide trend data for following items:

(1) Actuator response and positioning
(2) Hydraulic pressure, level, and temp
(3) Gyro tem/time
(4) Gyro spin up and spin down time
(5) Gyro output versus torquing stimulus

E. Monitor pump motor total starts, and the total run time.

F. Evaluation guidancepackage performance.

G. Monitor guidance input and offsets to the autopilot.

2. Tracking and Flight Safety

A. Monitor battery on line time.

B. Monitor SOCVU operate time.

C. Plot AGC voltage versus time.

D. Monitor all bus voltages.

E. Provide trend data for following items:

(1) Battery current/time profiles
(2) All SOCVU and switch operate times
(3) S & A operate times
(4) AGC voltage

3. Propulsion

A. Compute actual load during propellant loading by correlating level sensor, flow meter, tank calibration, pressure, and temperature data.

B. Provide tank pressure, and temperature readouts in engineering units.

C. Monitor and provide calculations on propellant tank temperature.

D. Expedite checkout of transtage helium, nitrogen, and attitude control system.

E. Provide trend data on following items:

(1) Tank pressure and temp
(2) Valve and pn valve time and position
(3) Start cartridge temperature

4. Electrical

A. Monitor all bus and battery voltages.

B. Monitor battery on line time.

C. Provide trend data on following items:

(1) Battery current/time profiles
(2) All switch and relay operate times.

5 Instrumentation

A. Provide automatic correction of calibration data.

B. Provide data and displays in engineering units.

C. Provide limits checks on all PCM data as a function of time and event.

D. Provide automatic or on demand ambient checks and print out.

E. Plot system calibration plots and print outs.

F. Provide computational capability for reducing data.

As a result of having the computer, the following additional capabilities will be available.

1. In flight monitoring and computational capability.

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3. Complete system status (vehicle, GOE, and GIE) at any time.

4. Administrative services such as

A. Procedure status and procedure writing

B. Test scheduling and monitoring

C. PERT critical path monitoring

D. Reliability success/attempts monitoring and tabulation

E. Configuration control

F. Spares status

G. Tabulate support requirements for all tests

H. Rework and retest estimates

I. Open items status and control

November 29, 1965

TO: Distribution

SUBJECT: Status of Martin-Denver DIMAC Effort (Report Two)

ENCLOSURES: (a) Project OCALA Progress Report, 12 November, 1965
(b) Background Report, 5 November, 1965 - R. Winckler

GENERAL

1. This report outlines initial analysis and recommendations for IBM support effort of the two booster check-out projects in Denver. The Eastern Test Range (ETR) IBM - Martin - Aerospace - Air Force joint study, also termed OCALA, and the Data Interrogation and Malfunction Analysis Computer (DIMAC) presently being specified by Martin for inclusion in the Titan III blockhouse at Vandenberg AFB in support of the MOL launches.

2. Discussions were held with Martin-Denver engineering, together with IBM Denver on November 23, 1965. Martin personnel contacted included: K. Gunderson - Senior Engineer, B. Pennington - Senior Engineer, J. Evans, Programmer, J. Hoerning - DIMAC Senior Programmer, R. C. Taylor - DIMAC Systems Engineer. IBM personnel were: D. Winckler and J. Stunkel.

DIMAC STUDY

1. The engineering and systems design effort by Martin associated with DIMAC is progressing rapidly and is in the final stages of definition at Martin. The Martin ILC Trade-Off Study Report X3-010, specifying Martin's recommendations for an ILC System for installation at Denver and Vandenberg, has been submitted to the Air Force/Aerospace Group for approval, pending release of a formal RFP for this system around February, 1966.

2. Rapport with Martin-Denver personnel is excellent and they seem anxious to work with IBM personnel in formulation and development of their check-out system. A copy of the ILC Trade-Off Report was informally transmitted to D. Winckler for analysis and comment. This report defines the general concept in detail and, after incorporation of the Air Force/Aerospace comments, will, in all probability, form the main body of the resultant RFP. Initial analysis of the content of this document clearly indicates they have incorporated the IBM proposed approach and have used quite a bit of data provided by IBM.

3. The DIMAC System, which is an essentially passive monitor/diagnostic system, has progressed to such a point within the Martin Engineering structure any attempt to directly influence Martin to incorporate a more active check-out system (similar to the Douglas proposed concept) would almost certainly result in failure and might jeopardise our rapport with Martin at this time, as:

1) the Martin/Air Force contract concept is based upon using a proven booster with a proven launch and check-out facility involving a minimum of modification prior to delivery

2) The MOL time schedule does not permit severe modifications in the Titan III launch procedure.

3) Martin Engineering feels present launch equipment is proven and has categorically stated to Air Force any modification of this equipment would jeopardize both schedules and launch reliability.

4) The Aerospace Systems Engineering Group will, in all probability, go along with the Martin check-out concept rather than place themselves in the position of being responsible for Martin booster checkout.

5) Martin Engineering personnel are, for the most part, opposed at this time to inserting a computer in the direct control link. They prefer to develop the safer approach of a passive monitor system until more operational data is available from other projects on the feasibility of using a computer as the major control element in launch and check-out.

Summary - DIMAC will perform complex analysis of countdown data in real-time which is not now possible, permitting more rapid recovery from hold. It will further provide a capability to analyze trends in an attempt to predict malfunctions prior to their occurrence, and generally should provide more information to meet "Launch On Time" criteria.

This function is felt by the Air Force and Martin to be sufficiently important to justify the design and production of the DIMAC system. While the DIMAC has been justified on the above basis, as an initial entry point for computers into the Martin checkout philosophy, this in no way precludes eventual implementation into the system of a complete control checkout loop. Martin Engineering is, in general, very interested in providing an open end to further employ the computer in performing more comprehensive checkout and control functions at a later date. In this regard, any effort on IBM's part to implement and configure the DIMAC system should take into consideration the possibility of eventually incorporating more direct control functions without requiring a major modification to the initial passive DIMAC approach.

During the meeting, it was stressed that the formulation of the DIMAC System is proceeding rapidly. Since this effort is now well under way at Martin-Denver and has a high probability of Air Force approval, it is recommended that a pre-proposal study be immediately initiated at Martin-Denver to define system hardware configuration and software support requirements involved in producing this system. Preliminary estimates of the effort required to handle this proposal indicates a team of 5-7 qualified members will be necessary for a 2-month period to develop and document the concept that would give IBM a high probability of obtaining the Martin computer check-out effort.

ETR STUDY

Further discussions specifically concerning the current ETR study effort in progress at Cape Kennedy brought out the following points:

1) The effort is being directed and evaluated by Martin-Engineering who are responsible at present for final approval of all elements of the task. This is the same engineering group that is specifying and will select the DIMAC system.

2) Martin, Aerospace and the Air Force will be very interested in performance of the study system at ETR. The study system will monitor 3 launches of the Titan-III booster (same as MOL booster). These launches are scheduled for February, April and June of 1966.

The system will monitor the data from the booster and subject it to limit checks (success criteria) developed at Martin-Denver, for the February launch. For the April launch the capacity to locate malfunctions will be added. All planned study functions will be operational for the June launch. This includes the launch checkout capability and elaborate calibration procedures.

3) Martin-Denver is currently manning the system analysis effort for the ETR study and has essentially completed initial analysis to the point of starting initial programming effort.

4) Martin-Denver is currently requesting an IBM programmer full-time to support the applications-programming effort, being conducted at Denver in support of the ETR effort. This effort will be conducted in Denver until approximately January 15 and then will move to the Cape through June 15.

5) Martin feels sufficient data is not available at this time regarding the operational details of the SPADATS Monitor to allow their programming effort to begin at Martin-Denver. In this regard, a meeting is set for December 1, 1965, where IBM programming personnel are scheduled to present the details of the existing SPADATS Monitor program to Martin programmers to allow them to initiate the applications-programming effort.

6) Since Martin-Denver is controlling the overall engineering management of the ETR, K. Gunderson felt it very desirable that IBM have a full-time systems engineer available from now until the first of January at Denver to handle the overall engineering coordination of the task between Denver and Cape Kennedy.

SUMMARY OF BASIC CONCLUSIONS

1. The ETR effort at Cape Kennedy and the DIMAC effort at Martin-Denver are two highly interrelated but separate tasks, both being developed simultaneously.

2. The outcome of the ETR effort will have a significant influence on the IBM posture in the MOL effort since any results will most certainly be interpreted by Martin and Aerospace as a reflection of IBM's ability to perform in this area.

3. An RFP for the DIMAC system will be issued in January, 1966.

4. The RFP will call for installation of the hardware in Denver in the fall of 1966. The system would be connected to the Denver check-out system and the total system developed for VAFB. The VAFB system would be installed in June of 1967.

5. It is highly probable that the Air Force will approve the DIMAC approach with only a minimum of modification.

6. Martin is completely sold on the passive role of the computer in the launch check-out of the Titan booster at this time. It being an ideal way to initally insert a computer into the system without upsetting those people (and the Air Force) not yet convinced of its value, as well as being a very useful method of increasing their "launch on time" score.

7. The ETR study will be closely controlled by Martin-Denver personnel. As presently implemented, it requires further support on the part of IBM at Denver, especially from the standpoint of programming help, as well as systems engineering management help to insure that the program is carried out successfully.

8. Under present schedules the ETR effort is actively in check-out early in January. Unless more careful attention is paid to the coordination of the Denver and Cape effort and more help provided, there is a high probability the present schedules will not be met.

9. If IBM submits a proposal on the DIMAC system, great care must be taken in configuring the system in such a way that eventual expansion of the computer role in check-out function can be added without a major modification in the basic system.

SUMMARY OF INITIAL RECOMMENDATIONS

1. Increased IBM support should be provided to the ETR study to insure its success. This should take the initial form of:

a) a coordinated engineering management approach (possibly centered at Denver).

b) the assignment of a full-time senior programmer to work with Martin-Denver at Denver on the application programming effort and transfer during the check-out of this effort to Cape Kennedy.

c) the provision of a full-time senior systems engineer to maintain the necessary engineering and management liaison with Martin-Denver and Cape personnel.

2. A pre-proposal team should be assembled immediately to start the configuration of the DIMAC system since almost all the engineering data required is now available and in the hands of Martin-Denver personnel. This team should, as a minimum, include one senior engineer experienced in vehicle check-out systems, one senior programmer, one engineer familiar with the 1800 system and an additional engineer (possibly part-time) familiar with the 360/44 system plus,representation on a systems engineering basis from WSC.

3. Steps should be taken to insure that the presently scheduled December 1 meeting to technically describe the SPADATS monitor system facilities is of technical value to Martin personnel.

4. A careful analysis of the SPADATS monitor program should be accomplished to insure that it indeed has the capability to meet the requirements of the ETR study. It is almost certain the some programming modification will be required at this time.

5. The problem of getting Martin to expand the computer's role in the booster check-out from a completely passive to an active system must be handled very carefully over a long period of time. Provisions can be considered and included in our design to permit this function to be implemented relatively easy later. This approach would be very favorably received at Martin-Denver.

Submitted by:

F. X. O'Rourke

R. T. Winckler

R. Winckler

FXO'R:jh

TITAN III ON-LINE COMPUTER

FEASIBILITY STUDY

Given to Col Miller - Monday, 20 Sept 65
(PRESUMABLY KIMOES)

DOCUMENT AEROSPACE USED TO SELL STUDY TO SSD.

MANAGEMENT RESPONSIBILITIES

- SSD/AEROSPACE
  - / PROVIDE OVER-ALL PROGRAM DIRECTION
  - / DEVELOP PROGRAM PLAN
  - / COORDINATE EFFORTS OF ALL PARTICIPATING AGENCIES
- MC/DENVER
  - / ESTABLISH SYSTEM ANALYSIS CRITERIA 3 sept
  - / ESTABLISH TREND ANALYSES AND DATA REDUCTION CRITERIA
  - / ASSIST IBM WITH PROGRAMMING DEVELOPMENT 2
- IBM
  - / ASSIST MC IN DEVELOPMENT OF SYSTEM CRITERIA ?
  - / DEVELOP DETAILED PROGRAMMING 3
  - / MONITOR LAUNCH OF VEHICLE #11, 12 AND 13
- 6555th ATW/AEROSPACE ETRO
  - / MONITOR ESTABLISHMENT OF SYSTEM CRITERIA ?
  - / PROVIDE DIRECTION ON PROGRAMMING DEVELOPMENT
  - / PROVIDE DIRECTION ON OPERATIONS PHASE

who develops equipment

who define exp. limits?

ROM COSTS[2]

- MMC

/ INTERFACE CABLING	$20,000
/ IN-LINE COMPARATORS	20,000[1]
/ ENGINEERING SUPPORT	80,000
	$120,000

how valid for what

- IBM

/ COMPARATOR SUB CHANNELS	$20,000[1]

- TOTAL COST $140,000.

(1) MAY BE POSSIBLE TO NEGOTIATE TOTAL PRICE TO $100,000.

(2) COSTS INCLUDE:

/ INSTALLATION AND CHECKOUT

/ TWO ON-LINE COMPARATORS FOR CONTINUOUS FUNCTION MONITORING

/ INTERFACE HARDWARE AND ENGINEERING

/ SYSTEM ANALYSTS AND PROGRAMMERS

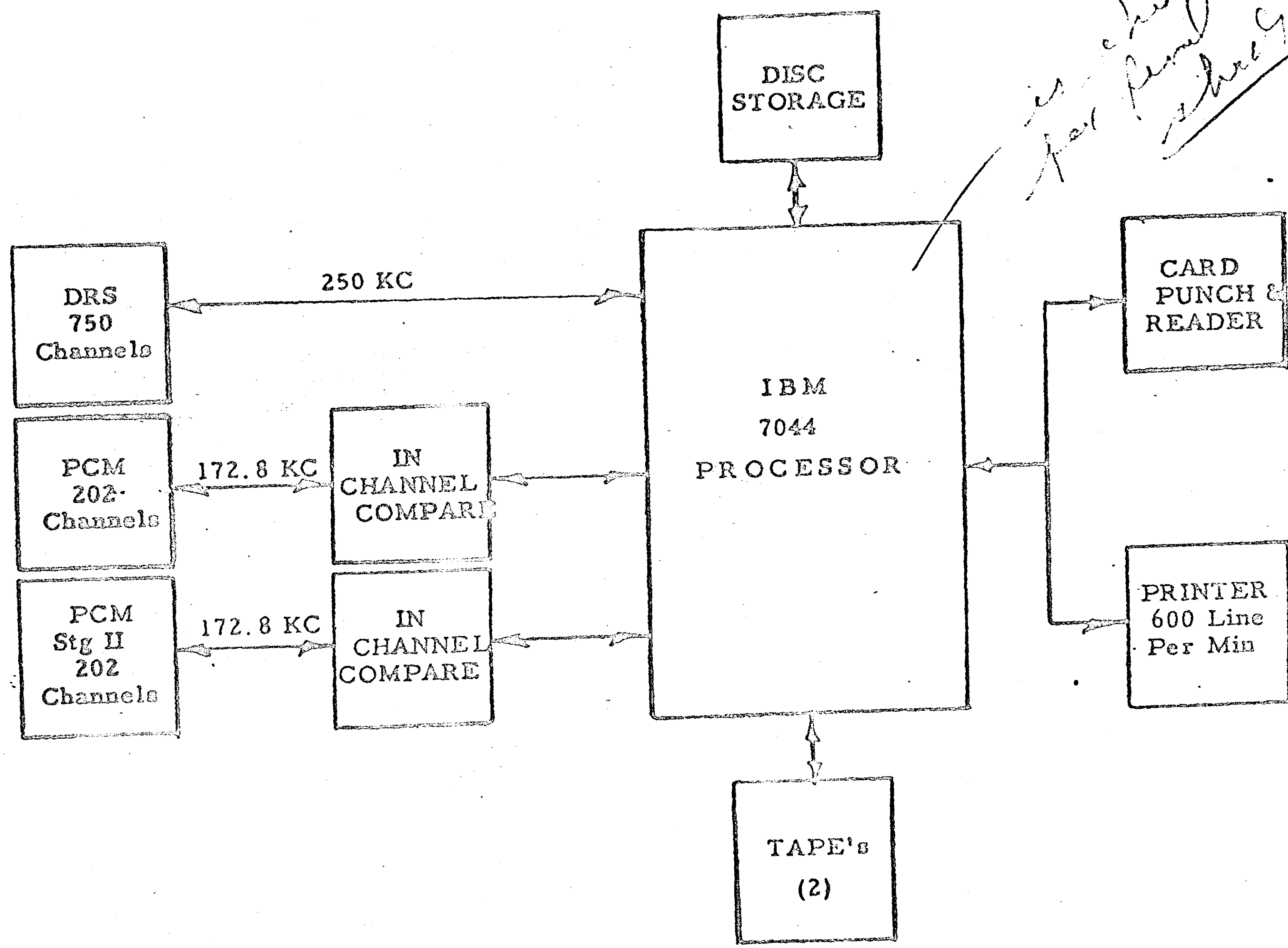
BACKGROUND

- UTILIZATION OF ON-LINE COMPUTER FOR MALFUNCTION ANALYSIS DESIRABLE FOR ILC
  - / PRELIMINARY SYSTEMS DEFINITION UNDER STUDY BY MARTIN COMPANY
  - / YIELDS RAPID MALFUNCTION ISOLATION AND ANALYSIS WHICH RESULTS IN HIGHER LAUNCH CONFIDENCE
- FEASIBILITY DEMONSTRATION CAN AND SHOULD BE ACCOMPLISHED AT ETR
  - / IBM SUBMITTED UNSOLICITED NO COST PROPOSAL
    - INSTALL 7044 COMPUTER AND PERIPHERAL EQUIPMENT AT ETR
      - / RAPID DATA REDUCTION AND LIMITED MALFUNCTION ANALYSIS
      - / SUCCESS CRITERIA COMPARISON
      - / TREND ANALYSIS OF DATA
  - / MARTIN COMPANY SUBMITTED UNSOLICITED ALTERNATE PROPOSAL TO WORK WITH IBM
    - PROVIDE CRITERIA AND ANALYSIS METHODOLOGY
    - ADD IN-LINE COMPARATORS
      - / INCREASES COMPUTER CAPABILITY

OBJECTIVES OF FEASIBILITY STUDY AT ETR

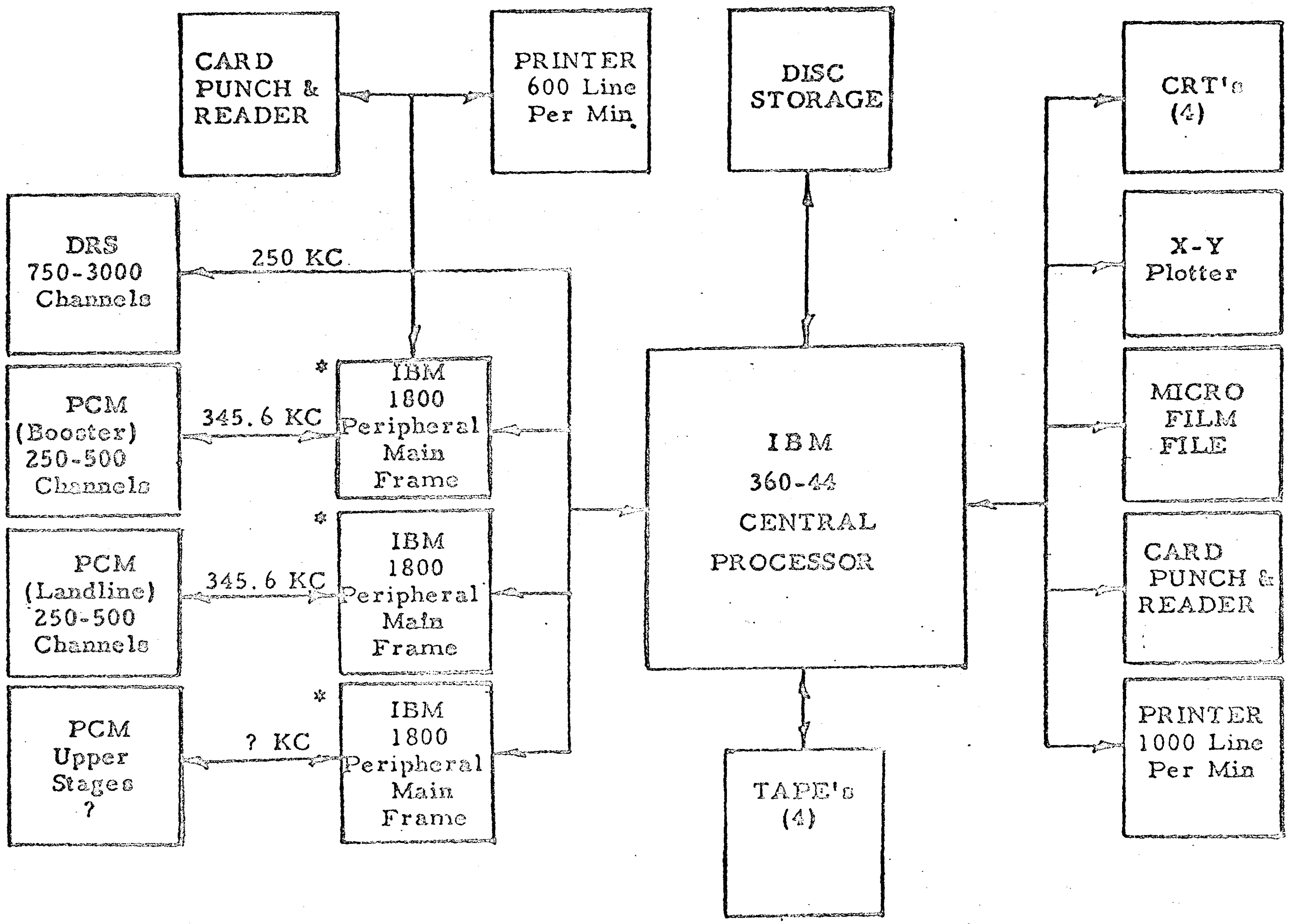
- DEMONSTRATE EFFECTIVENESS OF COMPUTER UTILIZATION FOR MANNED SYSTEMS
- DEMONSTRATE FEASIBILITY OF DETAILED RAPID MALFUNCTION ANALYSIS
  - INCREASE CONTINUOUS DATA EVALUATION
  - DIAGNOSTIC CAPABILITY
  - PERMITS DATA FAMILIARITY DURING ALL TESTING PERIODS

CONFIGURATION FOR ETR FEASIBILITY STUDY



PROPOSED CONFIGURATION AT ILC FOR MANNED SYSTEM

How About This?



* THESE UNITS HAVE IN-LINE LIMITS COMPARISON

COMPUTER MODES DURING CHECKOUT AND LAUNCH OPERATION

OUR PRESENT SCHEDULES ARE DIFFERENT THAN THESE

- COMBINED SYSTEMS TEST

WOW !!

	Veh. 11 FEB.	Veh. 12 APRIL	Veh. 13 JUNE
/ AMBIENT CHECKS			
○ IN-LIMIT CHECKS OF AIRBORNE SENSORS	70%	100%	100%
DRS Success Criteria ○ CHECKOUT OF CMG GO-NO/GO INDICATORS	100%	100%	100%
[illegible] Data ○ COMPARISON OF REAL-TIME CALIBRATION VS. PAST PERFORMANCE	---	100%	100%
○ PREDICTION OF PROBABLE LIMIT DECAYS	20%	60%	100%
/ TANK TOP PRESSURES			
/ N_2 AND He SPHERES			
/ VECOS			
○ DETECTION OF A MALFUNCTION	100%	100%	100%
○ AUTOMATIC READOUT OF DATA REQUIRED FOR MALFUNCTION ANALYSIS	50%	100%	100%
○ STORE TEST RESULTS FOR LATER COMPARISON	100%	100%	100%
○ PREDICTION OF LIMIT DECAY	20%	60%	100%
/ FREQUENCY RESONSE OF FLIGHT CONTROL SYSTEM			

[illegible] 2H13

COMPUTER MODES DURING CHECKOUT AND LAUNCH OPERATION (CONTINUED)

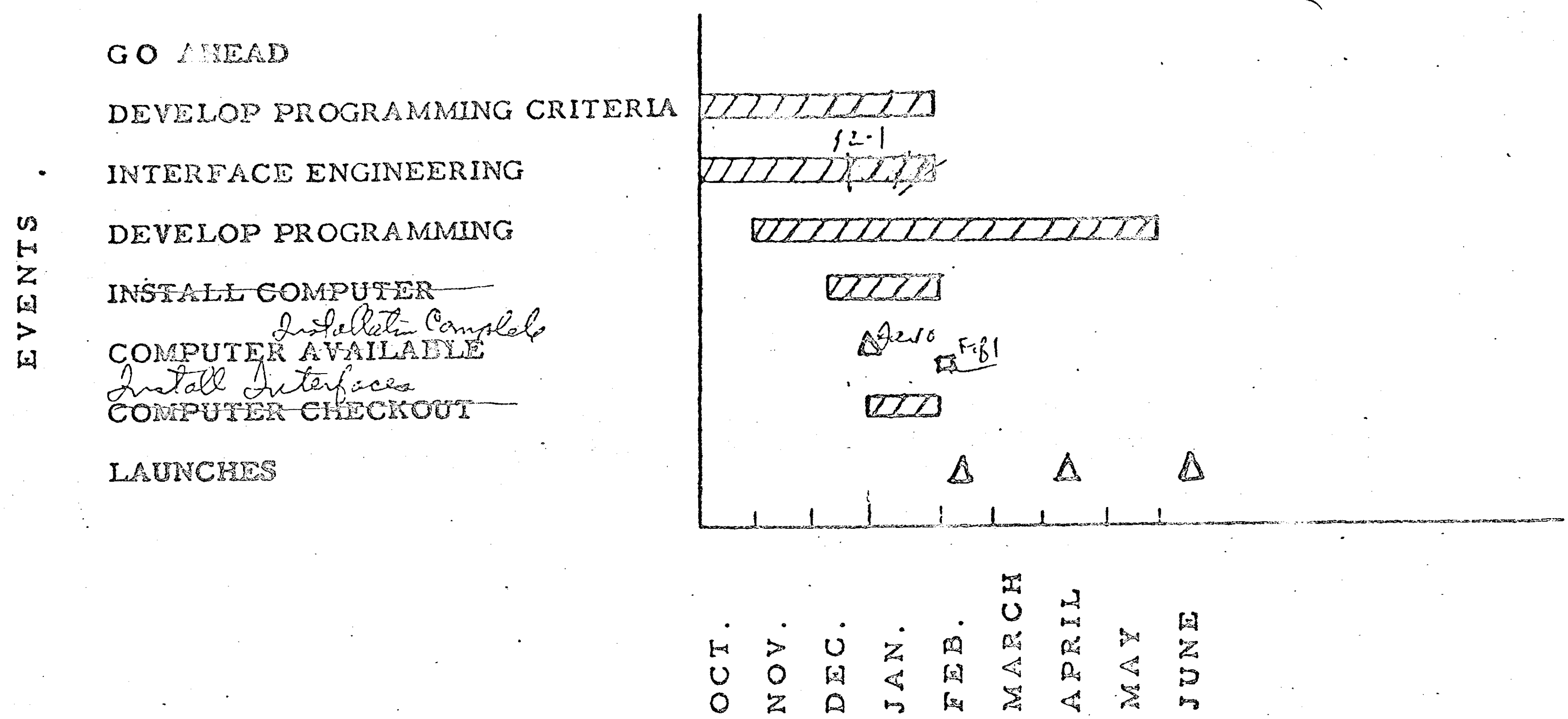
	Veh. 11 FEB.	Veh. 12 APRIL	Veh. 13 JUNE
/ COUNTDOWN/COUNTUP			
• COMPARISON OF DRS EVENTS VS. SUCCESS CRITERIA	100%	100%	100%
/ AUTOMATIC READOUT OF DATA FOR MALFUNCTION ANALYSIS			
• IN-LIMITS CHECK OF AIRBORNE SENSORS VS. SUCCESS CRITERIA	100%	100%	100%
/ PRINT-OUT DEVIATIONS FROM NORM			
• TRANSIENT CHECK OF LIMITED AIRBORNE SENSORS VS. SUCCESS CRITERIA	----	50%	100%
/ PRINT-OUT DEVIATIONS FROM NORM			
• ANALYZE HOLDS AND KILLS	40%	80%	100%
• STORE DATA FOR LATER COMPARISON	100%	100%	100%
O LAUNCH OPERATIONS			
/ COUNTDOWN			
• PROPELLANT LOADING; T-1 DAY			
/ MONITOR SYSTEM PERFORMANCE	100%	100%	100%
/ PROVIDE MALFUNCTION ANALYSIS OF PROBLEM AREAS	80%	100%	100%

COMPUTER MODES DURING CHECKOUT AND LAUNCH OPERATION (CONTINUED)

	Veh. 11 FEB.	Veh. 12 APRIL	Veh. 13 JUNE
o T-COUNT; AT SELECTED TIME FROM T-195 MIN. TO T-31 SEC.			
/ AMBIENT CHECKS	100%	100%	100%
/ MONITOR CMG AND DRS	100%	100%	100%
o PRESSURIZATION; T-160 MIN. T[illegible] T-31 SEC.			
/ ANALYZE TREND DATA	60%	100%	100%
o PREDICT TIME TO OUT-OF-LIMIT CONDITION			
o VECOS; T-55 MINS.			
/ SAME AS CST CHECK	50%	100%	100%
o TERMINAL COUNT; T-31 SEC. TO LAUNCH			
/ MONITOR REAL-TIME PERFORMANCE (DRS & CMG) VS. SUCCESS CRITERIA	100%	100%	100%
/ AUTOMATIC PRINT-OUT OF ANY HOLD OF MALFUNCTION	100%	100%	100%
/ AUTOMATIC PRINT-OUT OF DATA REQUIRED FOR MALFUNCTION ANALYSIS	20%	60%	100%
o LAUNCH PHASE			
/ RECORD T.M. DATA FOR RAPID PRINT-OUT CRITERIA	100%	100%	100%

2

SCHEDULE



TIME

1965-1966

IBM CONFIDENTIAL

AEROSPACE CORPORATION

INTEROFFICE CORRESPONDENCE

65-2150.64.6-525

C. R. Giacobine   cc see below   DATE 28 October 1965

SUBJECT Trip Report - Computer for ETR Meeting at Cocoa Beach on 25-26 October 1965

FROM J. J. Kimose

J. J. Kimose

The meeting convened to determine organizational setup, ground rules and how the system would be configured. The organizational block diagram is shown in attached Figure 1. A more detailed schedule is shown in Figure 2.

The following ground rules were established:

1. The central points of contact are established as follows:

Organization	Name	Address	Phone
SSD	Capt. N. North	SSBTA, Los Angeles	643-1402
IBM	B. Blue	7900 N. Astronaut Ave. Cape Canaveral, Fla.	784-9622
Aerospace, El Segundo	J. Kimose	2400 E. El Segundo Blvd. El Segundo, Calif. (B/2034)	648-5536
Aerospace, ETRO	W. Dillon	Box 4007, 624A Program Patrick Air Force Base, Fla.	853-5695
6555th ATW	D. Jacobs	6555th, DWBS PAFB, Fla.	853-9071
MC, Denver	A. Ash	Box 179, Denver, Colo. Mail Station E 456	794-5211, x: 4595
MC, ETRO	D. Mackey		

GUNDERSON'S SUPERVISOR
ASH DIDN'T PARTICIPATE IN
DENVER MEETING

2. SSD/Aerospace shall serve as Program managers. MC/Denver shall serve as integrator for all efforts pertaining to the study definition, implementation, installation, and final study report upon completion of the program. The final report shall include the inputs of each agency participating in the study. Copies of the report will be provided to the central points of contact.

3. Aerospace will provide two programmers and one systems analyst. One programmer from ETR and one programmer from El Segundo. The systems analyst will be made up of several people part time.

4. IBM will provide the computer, computer maintenance, two programmers and a systems analyst.

Blue

5. MC/Denver will provide the in-channel comparators, interface adapters, fifty (50) hours of 7044 computer time, 2 programmers and 3 system analysts. MC/Denver will provide the systems analysts in Denver until 1 Jan. 1966, when the major effort will be transferred to ETR. For the remainder of the study MC/Denver and MC/Canaveral will jointly provide systems analysts.

6. MC/Denver will retain configuration control for all software and hardware. They will document the study tasks by the normal FEDCP route using sketch engineering and modifications. These will initially be maintained in a single document and a copy provided to each of the single points of contact. AND WILL WRITE FINAL REPORT.

7. The computer will be installed in the Instrumentation Room in the Vertical Integration Building (VIB). IBM will furnish detailed computer requirements to MC/Denver for its installation by 1 November 1965.

ATTACHED

8. The study will encompass as a guide the briefing document entitled, "Titan III On-Line Computer Feasibility Study," dated 20 September 1965. (All interested parties have been furnished a copy.)

9. All agreements will be documented by the originator and distribution made to the central points of contact. These shall include telephone calls, TWX's, and meetings.

A meeting was scheduled for the week of 1 November 1965, to define to the working level people the systems program definition, data format and data flow. It will work within the established ground rules and work out the details to implement the study. IBM will define and explain their monitor program. The programmers and analysts will decide on the most efficient format for data transfer between these working groups.

JJK:jm

Attachments: Figure 1
Figure 2

cc: Lt/Col F. Kniss, SSBD
Maj. L. Daniels, SSBT
Capt. N. North, SSBT

D. Baxter
L. Chevlin
W. Dillon, ETR
T. Hanrahan, ETR
W. Hodson
S. Lafazan
W. Lyons
D. Miller
R. Schack
A. Shier
R. Whalen
Central Files

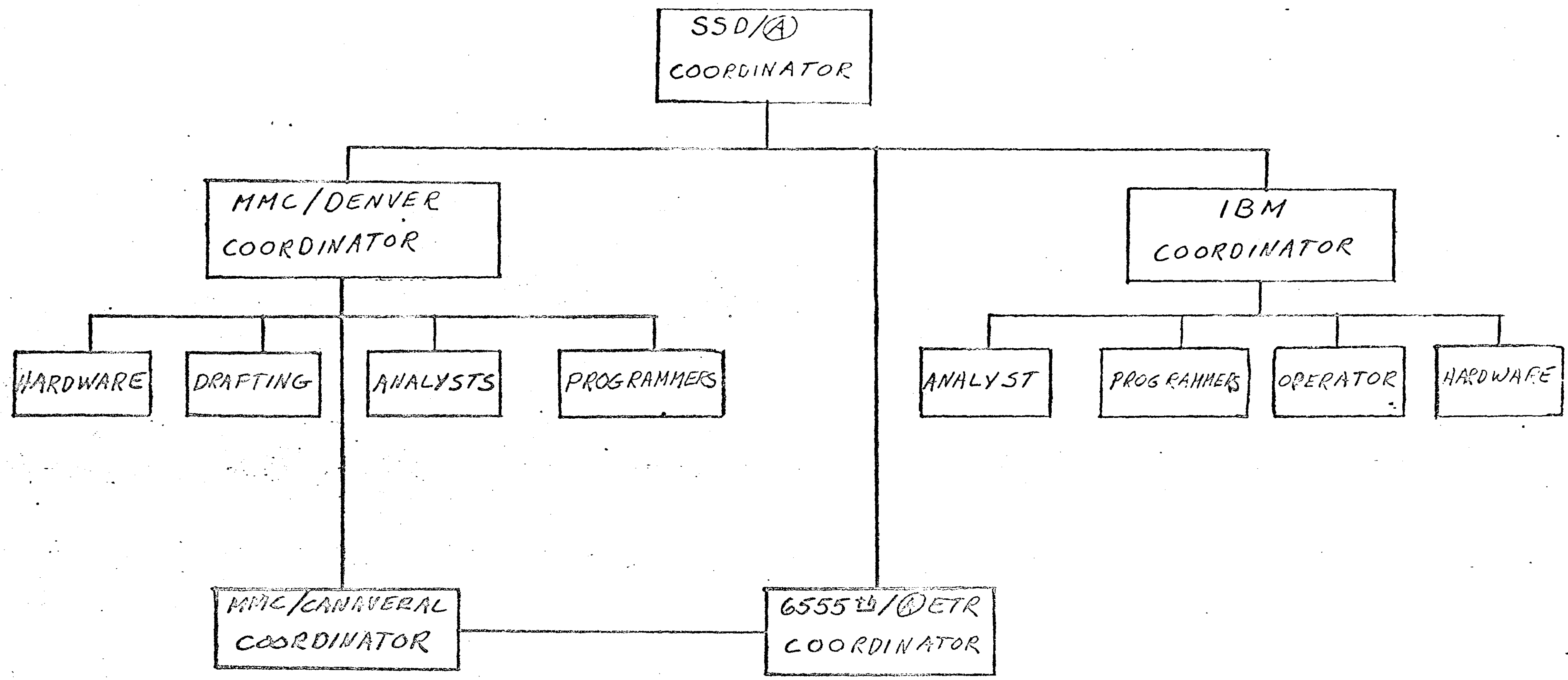


Figure 1

STUDY PROGRAM ORGANIZATION

Section 5.1

F[illegible]re 2

Item	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1. Go Ahead	25								
2. Develop Success Criteria									
a. Preliminary Data for LV-8		2							
b. Released Document for LV-11				1					
3. Data Format Definition Frozen for Programmer		15							
4. Interface Engineering Complete			1						
5. Develop Study Program Definition									
a. Informal Definition		2							
b. Preliminary Draft of Document		15							
c. Publish and Distribute Final FEDCS Document				1					
6. Monitor and Service Programs Running			1						
7. Computer Installation Complete				10					
8. Operational Programs Checkout									
a. LV-11					1				
b. Continuing Throughout Study									

NOTE: Success Criteria shall be available at least one (1) month prior to CST for each launch schedule and shall be updated on a continuing basis.

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WORK STATEMENT

The purpose of this project is to gain experience in the use of an on-line digital computer for data analysis during Systems Tests and Countdown of a research launch vehicle. These tests are to establish guide lines for developing a system concept, hardware design, computer programming, manpower and cost requirements for an operational OCALA system.

An available computer with more than adequate capacity to meet the presently anticipated requirements will be connected to the existing Titan III Ground Support Equipment (GSE) to conduct the tests. The existing Titan III test and data analysis procedures will be evaluated to select representative tasks which can be expected to exercise the system design parameters. These tasks will be converted to computer based analysis, programmed and tested under simulated conditions. A Monitor program will be developed to sequence task execution according to time, events and operator control. When this program has been thoroughly tested, the on-line connections to the GSE will be made and operational tests will be conducted. Operating experience will be evaluated in terms of the original system design criteria.

EQUIPMENT

The Ground Support Equipment (GSE) in the Instrumentation Room of the VIB provides access to all of the signals used in system test evaluations. An IBM 7044 Data Processing System will be tied into the existing GSE without interfering with the current use of the equipment. The computer configuration and GSE interfaces are described in the following.

COMPUTER

The IBM 7044 Data Processing System is a general purpose binary computer that has been adapted to on-line data processing by the addition of the 7288 Data Communications Channel. The computer has a 37-bit word and a basic core storage cycle of 2.0 microseconds. Processing and input/output operation is overlapped. The configuration required for the study (Figure 1) includes a 1301 Disk Storage Unit, two 729V Magnetic Tape Units, a 600 line-per-minute 1403 Printer and a 1402 Card Read Punch. A physical installation plan for the VIB is shown in Figure 2. A complete list of the 7044 system units is given in Table 1.

GSE/COMPUTER INTERFACES

Four connections must be made from the GSE to the computer to acquire the data necessary for real-time and postflight (test) analysis. Telemetry data from two of the ASTRODATA PCM ground stations will be fed to two 7288 subchannels. Event data will be obtained from the slave Data Recording Set (DRS) as it is recorded on tape. Range Time will be obtained from the slave DRS time decoder.

PCM Interface

Data from the PCM links will be obtained from the Data Storage Registers (DSR) in the Astrodata Ground Stations in the Instrumentation Room. Eight bit syllables will be transferred as they are assembled in the DSR (Figure 3) to a variable character input (VCI) subchannel adapter in the 7288. The function of this subchannel is to provide controls and data buffering to assemble four syllables from the telemetry link into one 36-bit computer word. The subchannel will gate the entire 960 syllables from a major frame into a block of computer storage starting with the first syllable after the main frame sync pulse is received. It will transfer the next major frame into an alternate storage block and then return to the first block to provide a continuous reading of all data from one PCM link at a time. The syllable sync timing pulses from the Accumulator/Decommutator will cause the subchannel to store each syllable in its input register. After four syllables are stored the subchannel control requests a computer storage cycle.

DRS Events

The DRS writes a seven bit parity checked character on a computer compatible magnetic tape. The output to the tape write amplifiers will also be transferred to a variable character input subchannel where six 6-bit characters will be stored per 36-bit word (Figure 3). The 62.5kc clock signal from the DRS will cause a character to be shifted into the subchannel input register. The tape start signal from the DRS will signal the computer that an event has taken place.

Time Code

The DRS contains a time decoder chassis which decodes the range time code into hours, minutes, seconds and hundredths of seconds. The 26 bits required to represent time to the nearest 10 milliseconds will be transferred in parallel to a Parallel Input Subchannel in the Subchannel Adapter Unit. A time word will be stored by the computer each time a main frame sync pulse is received from either PCM ground station. These connections require engineering modifications in two Astrodata Ground Stations and the slave DRS. The 7288 will not generate signals that interfere with the normal use of this GSE.

In Channel Compare

The computer will maintain a current table of data limits in core storage for all PCM syllables. These limits will be transferred to a hardware comparator in the PCM interface equipment thru a variable character output (VCO) subchannel. Each syllable will be compared against the high and low limits as it is transmitted to the VCI. If it is outside the set limits a bit will be placed in the 9th bit position of the syllable storage location. An out of limits interrupt will also be signaled to the VCO. The output limit data and input data stream will be synchronized by means of the main frame sync pulse.

TABLE I

Machine Type	Model/ Feature	Description
7107	3	Processing Unit
	#3880	Extended Performance
	#4428	Floating Point Arithmetic, Single Precision
	#7498	Storage Clock - Interval Timer
	#1845	1st 7904 Channel Attachment
	#1846	Two Additional 7904 Channel Attachments
1414	4	I/O Sunchronizer for Card R/P and Printer
	#6025	Read and Punch Col. Binary
	#7680	Synch. Storage - Printer
	#7681	Additional Synch. Storage - Printer
1414	001	I/O Synchronizer for Magnetic Tape
1402	002	Card Read Punch
1403	002	Printer
7904	002	Data Channel (2)
	#1074	Control Adapter for File
1301	001	Disk Storage
7631	002	File Control
729	006	Two Magnetic Tape Units

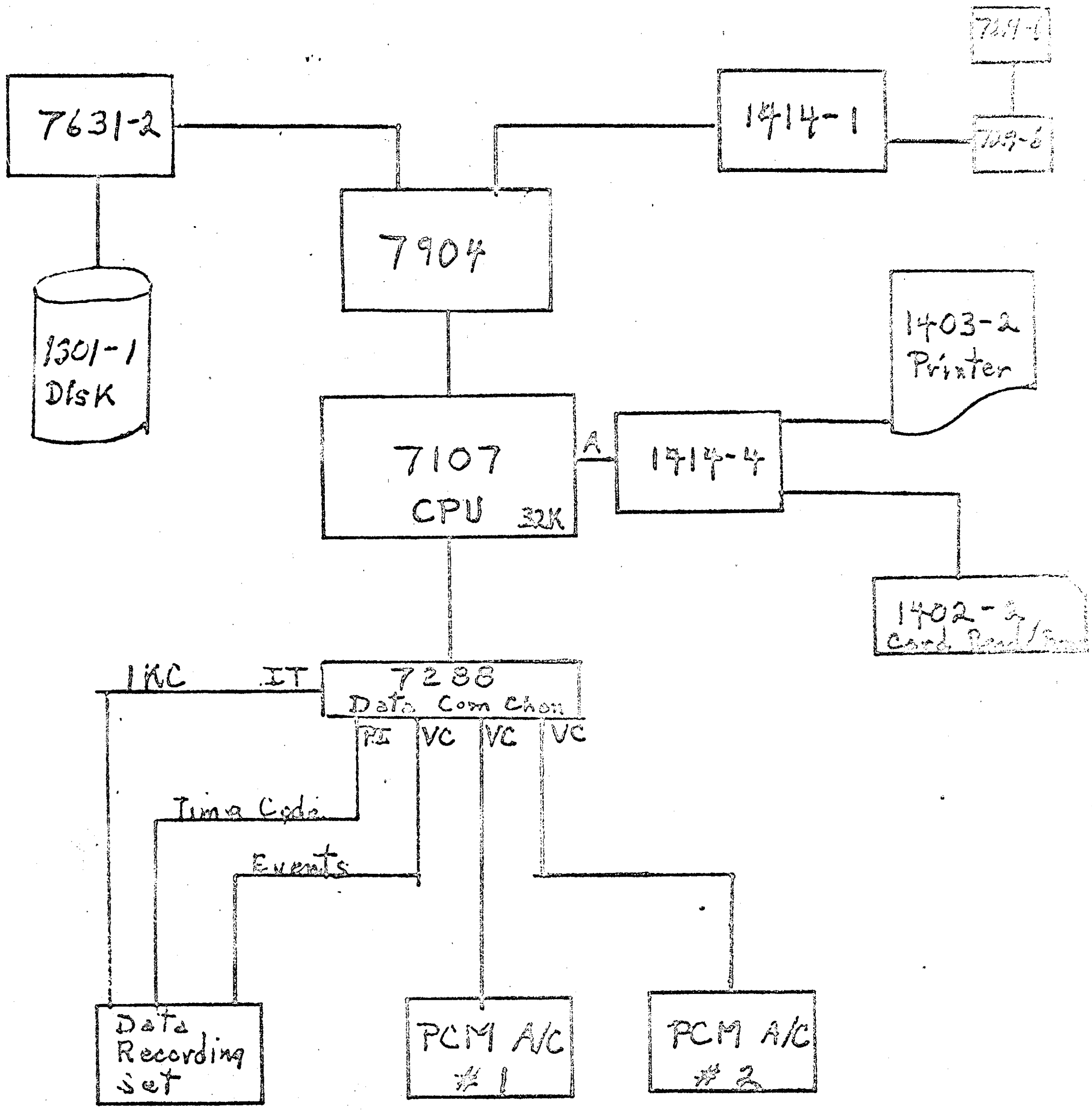
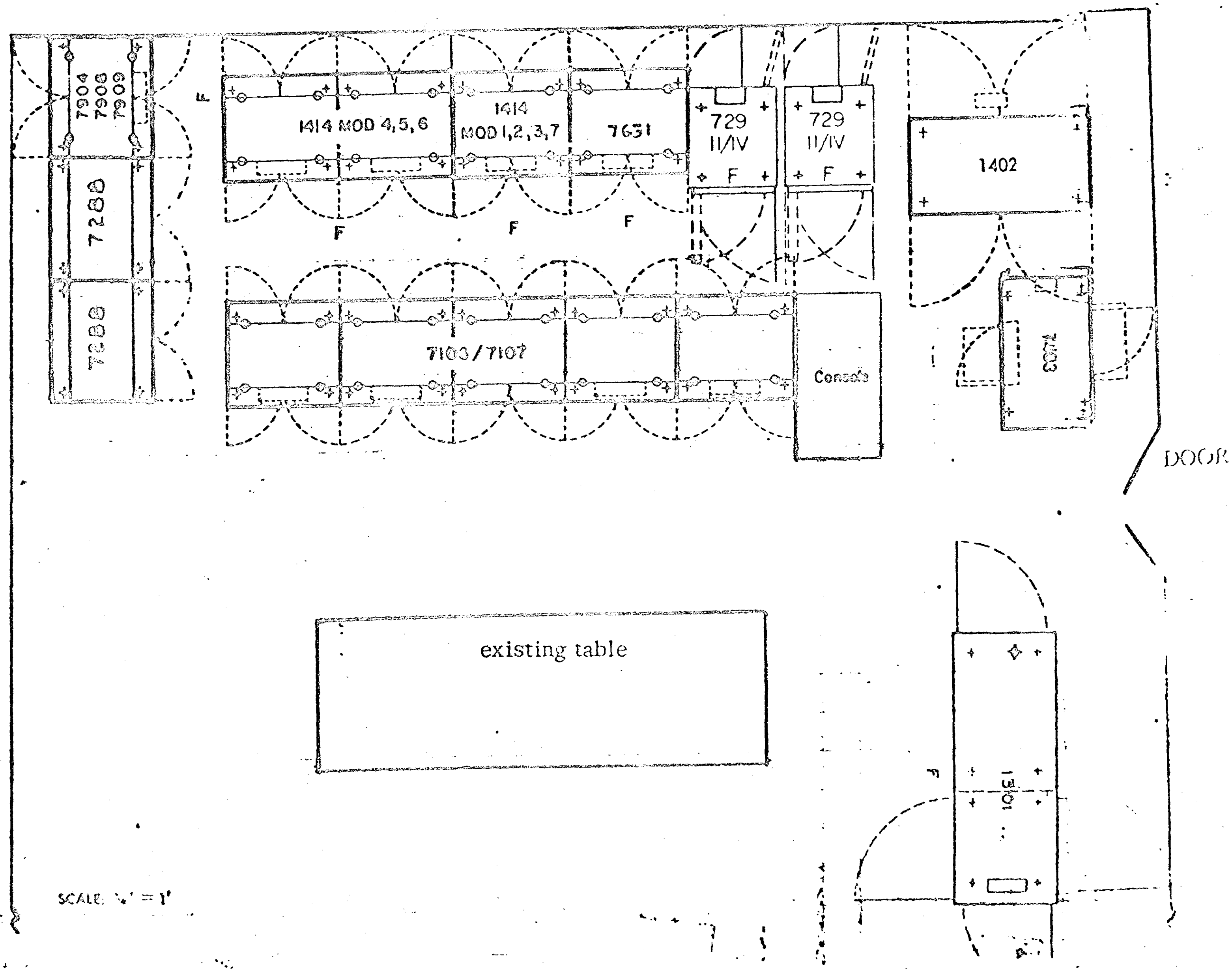

7631-2
1414-1
7904
1301-1 Disk
1403-2 Printer
7107 CPU 32K
A
1414-4
1402-2
7288 Data Com Chan
IKC
IT
VC
VC
VC
Time Code
Events
Data Recording Set
PCM A/C #1
PCM A/C #2

FIGURE 1

INSTRUMENTATION ROOM



November 5, 1965
DENVER

Denver Branch Office Support of IBM-Martin-Aerospace Corporation - Air Force Joint Study

Mr. R. M. Umbreit
Marketing Manager
DENVER

On November 1st the subject study was begun with the participants meeting in Denver.

Original Study Background:

This study was first conceived at Cape Kennedy between an IBM SDD Representative (Robert Blue) and the Air Force Test Wing of SSD (Space Systems Division). The study was to prove the value of a computer in the real-time monitoring of the launch countdown of space boosters. The study was to specifically be used to monitor two Titan III C firings in February and April, 1966.

IBM hoped to gain new insight into the requirements of such a system, both hardware and software, to permit it to compete more intelligently in this large but intensely competitive market. The Air Force saw in the study a cost justifiable way to gain the same knowledge. They expect that the computer used in this way, will provide huge savings through minimizing the tremendously expensive time it takes to check out and launch a complex space booster.

IBM, (FRO-SDD) initially proposed to support this study with two programmers for six months and a rent free IBM 7044-7288 System for four months. The Martin Company (Eastern Test Range Office - ETRO), the Aerospace Company (ETRO) and the Air Force Test Wing (located at Cape Kennedy) all agreed to provide support - if the study were approved. All of these Florida based groups report directly or indirectly to Martin's customer (in Los Angeles). The Air Force's Space System Division (SSD) and their "consultants" the Aerospace Corporation. It is the combination of these latter two that would have to approve the study.

ILC Study Contract:

At the same time that this joint study was being proposed the Martin Company in Denver received a study contract from SSD/Aerospace to design the ground support facility (Integrated Launch Complex or ILC) to be used to support the launch of Titan III-C's in the manned orbital laboratory (MOL). It was for facilities such as this that IBM hoped to gain sufficient knowledge through the study to enable it to sell use of IBM computing systems.

Conflict of Studies:

The joint study proposed in Florida was to run from October, 1965 through April, 1966. To meet the established MOL schedule, the ILC must be defined and hardware ordered by February, 1966.

Martin/Denver (M/D), though cognizant of the joint study proposal, refused initially to participate. They felt that the study was inadqquately supported to accomplish its goals. Not only was there too little time allotted and too few people assigned, but there was no provision for needed system support to define what the computer was to monitor. The needed system support was only available from M/D systems engineering. M/D was also concerned that if the study failed, it would reflect negatively back on their concept of using a computer in their ILC proposal.

Joint Study Resolution

Several factors combined at this time (September) to convince all parties concerned that a study should be conducted, but on a different basis than originally conceived. The study should be a prototype of M/D's ILC approach. It should not only prove the value of a computer in this application but it should specifically prove that the way M/D proposed to use a computer in ILC was valuable and possible.

To achieve this goal, the study must be designed by M/D systems engineers. This has all now been agreed to and the study is off on this basis.

All of the participants have gained from this modified direction. M/D has the opportunity to prove its ILC approach to its customer. SSD/Aerospace will be able to see this proof before they are asked to buy it. IBM has probably gained the most of all. We are not only going to learn about 'checkout', we'll be involved directly in the development of the specifications for ILC and working directly with those who will select the vendor to supply the computing system.

Conduct of the New Joint Study:

As mentioned above, the study will be conducted just as any other Martin project is. SSD/Aerospace will approve and oversee the work. M/D will control the design and development, and oversee its implementation. The implementation will begin at Cape Kennedy when the 7044 is installed January 1. At that time SSD (ETRO), Aerospace Corporation (ETRO) and Martin Company Cape Kennedy personnel will assume control of the implementation.

Study Organization - Request for Branch Office S. E. Support

The study is presently staffed as follows:

Systems Analysis

3	M/D	Persons
1	IBM	(Blue)

*

Application Programming

1 M/D Programmer

1 Aerospace L.A. Programmer

1 Aerospace E.T.R.O. Programmer

**

Monitor Programming

2 IBM (FRO - Cape Kennedy) Programmers

1 M/D Programmer
***

Hardware Coordination

1 IBM (Blue) Computing System

1 M/D Special Hardware and Interfaces

* W. B. Gibson is working on providing FSD systems man from Huntsville to utilize and promote IBM experience in check out.

** I propose that we supply a minimum of one especially-competent IBM Systems Engineer from the Branch Office to participate in applications programming. This is an ideal time and place to gain the local experience necessary to enable us to sell to Martin/Denver IBM systems for the ILC.

*** Understand W. B. Gibson has approval for an additional man familiar with the real-time monitor that is to be used in the study.

Study Schedule and Location

Preliminary targets call for some on-line monitoring of a Titan III C launch in February, 1966. Additional capabilities would be operational by an April launch. All facilities planned for the study would be used to support the launch scheduled for June. (IBM has agreed to extend the study through June.) Following this, M/D will report the findings of the study to SSD/ Aerospace.

The study will be chiefly located in Denver until the computing system is installed at the "Cape" January 1, 1966. Systems Analysis will be performed by M/D personnel in Denver and supported by Blue at Kennedy after January 1. Applications programming would be done in Denver until January 1, at which time it would move to the Cape. Monitor programming will be done at the Cape by IBM with liaison provided to Denver applications programmers.

Related Background Data

M/D's current ILC concept is an extension of the functions to be performed in the joint study with the 7044. This calls for the computer to be a passive or "non launch critical" element in the system. It will monitor all events and provide valuable information regarding the status of the countdown. Its most important function will be to analyze and locate malfunctions so that they can be corrected with a minimum delay. It will not issue stimulus to the booster. This will be done by special equipment in the manner that has proven satisfactory for all Titan launches to date.

The fact that the computer is not being proposed to perform this last function has opened their proposal to outside criticism and concern. Their approach is a conservative one. It is safe and it can be implemented in the time available. Nevertheless, it is not the approach being taken by NASA's Saturn Project. There, the computer is performing all launch checkout functions. Specifically, this includes "closing the loop" by having the computer issue the commands to the booster during the count, as well as monitor the systems response. This additional function provides flexibility that is considered by many to be particularly valuable.

Those who support the more sophisticated (NASA) approach include the MOL capsule contractor, Douglas Aircraft, and some of their contacts within SSD and the Aerospace Corporation. It is Douglas's plan to perform their capsule checkout completely by computer.

SSD/Aerospace had implied that they would prefer that one system should serve both contractors.

A meeting was held at Douglas on November 4 to determine if there needed to be any changes in approach to support the entire MOL Project. The attendees included M/D, Douglas SSD and Aerospace. It was decided that it was not in the best interest of the project to attempt to support both participating contractors with a single computer system. The customer (SSD/Aerospace) was convinced that each contractor had valid reasons for pursuing the different approaches. (It is still likely, however, that Douglas' capsule will be monitored by Martin's ground equipment as well as by Douglas. Martin's monitor will perform a more complete status check.)

Competition

The M/D ILC study is now completing its first phase. Martin is about to submit its report of how it intends to launch the MOL.

During the first phase most computer manufacturers were contacted and invited to submit recommendations and/or proposals to fit the application. Serious solutions were presented by Digital Equipment, Burroughs, G. E. and IBM. M/D is known to be pleased with D. E. C. and IBM's solution and are essentially using them as reference systems in their report.

Our solution includes one System/360 Model 44 interconnected to four "front end" 1800 Systems. D. E. C. presented an attractive package of a PDP 6 and 4 PDP 7's - all sharing a common memory. Further, the common memory can be partitioned to specify different processor priorities in different blocks of storage.

The next step will be for the Air Force to approve of the Phase I report. Then M/D will prepare an RFP and select the vendor. This was to have been accomplished prior to February 15th to permit hardware installation in Denver by September 1966. The new joint study could affect this schedule. Much can be done on the 7044 that was to be done on the system in Denver between September 1966 and July 1967.

The ILC would be operational at Vandenberg by ~~July~~ Nov of 1967. The system at Denver might be transferred to Vandenberg but more likely an additional system would be installed there. The third possible system would be to support other Titan III C launches at Cape Kennedy.

IBM Order Status

The system which we presented amounts to about $40,000 points or $2,000,000 purchase. The potential exists for as many as three of these systems.

To establish a delivery schedule for bidding purposes we entered orders for five System/360's (Model 44's) and five 1800 Systems. The extra 44's were ordered as possible substitutes for 1800's in case of either capacity or delivery problems.

Shipping dates established were for one Model 44 in late August 1966 and four for late September 1966 and mid 1967 for the 1800's. To present the most attractive proposal we should be able to deliver two 1800 Systems with the August Model 44. (Seems we should be able to swap circuit production between the Model 44 and the 1800.)

To meet any special hardware requirements of these systems we hope to be able to call upon F. S. D. We don't expect much help from S. D. D.

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DISTRIBUTION: Attendees,
W. B. Gibson,
J. J. Selfridge,
Project Notebook.

Report on Meeting November 29, 1965 concerning Martin-Denver Checkout System

This meeting was attended by the people listed on the attached roster. The meeting discussed the situation, problems, and alternatives concerning the Martin-Denver Checkout System "DIMAC" and the effort at Cape Kennedy using the 7044-7288 headed by R. Blue. The agenda of the meeting is also listed in the attachment.

Many of the questions could not be resolved at the meeting but certain conclusions were reached and a plan of action evolved.

Conclusions:

1. Since both DIMAC and the 7044-7288 (ETR) study at Cape Kennedy are operating under the direction of the same Martin System Team, as much as possible should be done to further the ETR study. In this view it was felt desirable if, at all possible, to supply a programmer from IBM to work with the Martin personnel at Denver, working on the object programs for the ETR study. He should provide the interface knowledge for the "SPADATS" monitor and the object programs and in actual writing of object programs with the Martin people. It would seem best at the time that he report to R. Blue although assigned at Denver until January 15, 1966. When the Martin group moves to Florida in January a decision can be made whether to continue the programmer or withdraw him in favor of phasing other of B. Blue's people into the task.

2. A concerted effort should be mounted to get the best proposal for the "DIMAC" R.F.P. which is expected in January or February, 1966. This system will probably result in 40,000 points of business. Since we have good relations with the Martin personnel and advance information about the system requirements, we appear to be in a good bidding position.

The plan of action is as follows:

1. Four people will spend the remaining portion of the week (November 30 - December 3) at Denver to analyze Martin requirements, proposal requirements, and marketing strategy.

2. Prepare a report documentary this study effort and recommendations, including:
   1, Personnel required,
   2, Target date schedules,
   3, Any special requirements

A. Ryff.

Martin-Denver Checkout System
Meeting Attendees

NAME	LOCATION
Dick Winckler	Denver (Martin)
Dick Stanley	VAFB - LA GEM
Gerald Boruski	Los Angeles - (5th Floor)FSD
A. J. Monaco	Los Angeles - Scientific
Bill Hess	Los Angeles - Scientific
John Jones	FSD
C. Brown	MOL
Ted. Charbonneau	MOL
Frank O'Rourke	MOL
Al Ryff	MOL
P. W. Melitz	Aerospace Industry Marketing
A. J. Albrecht	Los Angeles - (5th Floor)FSD

AGENDA MEETING NOVEMBER 29, 1965

Re: MARTIN - DENVER CHECKOUT SYSTEM

1. Discuss DIMAC concept as proposed by Martin-Denver and outlined in their specification from standpoint of status, problems, potential and value to the IBM Corporation aerospace effort.

2. Discuss the status of ETR study, stressing the schedules, present status and problems.

3. Discuss the relationship of the proposed Martin check-out system with the contemplated VAFB check-out concept and approach.

4. Discuss problem of general IBM support in these areas, from standpoint of what is needed to get the business.

RESOLVE:

1. Size of proposal effort (if any) required for DIMAC.

2. When the effort should start, how long it should last and what output is expected.

3. Major problems in proposing on this system, including RFP date (contemplated), special equipment required, special program required and possible value, whose proposal FSD or DP?

4. How the ETR effort should be handled, coordinated and staffed to meet present commitments, especially from standpoint of what manpower should be provided.

5. Names or numbers of IBM personnel required to handle present stage of these efforts.

6. The way both efforts, ETR, DIMAC, fit into the goals of the Los Angeles MOL project group.

7. What are plans to handle expected hardware delivery problems from standpoint of standard and special hardware requirements.

TRIP REPORT CONCERNING TRIP TO WASHINGTON SYSTEM CENTER, BETHESDA, MD.

PURPOSE: Discussion of possible DIMAC hardware configuration and recommendations for an eventual optimum configuration.

DATE OF TRIP: 12 to 14 January, 1966.

ATTENDEES: Val Adams, Bob Bruns, W.Gourlay,Jr., Joe Melville, Bob Moeller, Wes Peavy, Dick Rivett, A.L.Ryff, F.X.O'Rourke, C.P.Strive. R.T.Winckler.

I. RESULTS:

The discussions on 13 January,1966, were primarily of a familiarization and educational nature and were, for the most part, accepted without significant technical comment by WSC personnel in attendance.

On the whole, the WSC engineering group were not in a position at this time to go into any of the detailed design considerations related to a specific DIMAC configuration, which might be fabricated by them.

After about 5-1/2 hours of engineering discussion, WSC personnel expressed a desire to cancel the engineering conference tentatively scheduled for the following day, to allow them time to consider and review data already presented and to more thoroughly discuss possible approaches with other WSC design engineers not in attendance.

It was agreed that a copy of the formal DIMAC system specification (currently scheduled for completion 25 January, 1966) would be forwarded to this group, prior to 1 February, 1966, for their use in configuring a hardware approach that would meet the overall system requirements. In this regard, WSC agreed to have an initial hardware approach defined for review and comment (together with an "area price") by March 15, 1966. The concept submitted would be one suitable for design and fabrication by FSD personnel at WSC.

WSC is further planning to attempt a definition of a hardware approach for the PCM and DRS comparator channels required for implementation of the DIMAC configuration, utilizing 1800 processing equipment. This hardware would also be fabricated by FSD at WSC for eventual integration with the 1800 systems. The date for this proposed configuration is also March 15, 1966.

II. PLANNED ACTIONS:

As a result of this meeting, the MOL Project Group will forward three copies of the final system specification, together with associated block diagrams and reference material to W. Peavy, WSC Bethesda, Md.

R.T.Winckler of IBM, Denver, is planning to submit a formal RPQ to Poughkeepsie in parallel with the WSC effort, to determine what their approach to the ROS comparator concept would be, both from the standpoint of hardware configuration and their particular desire to fabricate this type of equipment in light of the scheduled nine month delay for the DIMAC system.

Further meetings are planned to be held with 1800 personnel (especially the group at San Jose) with regard to their implementing a special comparator unit for use in the 1800 system.

REFERENCES:

Detailed minutes of this meeting have been assembled. They completely document pertinent questions and comments presented during discussions on 13 January, 1966. This document (34 pages) has been placed in the DIMAC conference file and is available, on request, by personnel associated with the project who may be interested in reviewing the detailed contents of the discussions.

1-17-66

P. X. O'Rourke

FXO'R:jh

Distribution:

G.Boruski, C.B.Brown, W.B.Gibson,
W. Gourlay,Jr.,J.E.Hamlin, W.Peavy,(4 copies)
at WSC,Bethesda; A.L.Ryff, J.J.Selfridge,
R.Winkler,IBM Denver (2 copies), Project File.

IBM CONFIDENTIAL

IBM

Date: January 17, 1966
From (Dept/Loc): 104
Telephone Ext.:

Subject: Titan III ILC Schedule

Reference:

To: W. B. Gibson

Mr. Kent Gunderson project engineer for DIMAC told me that the Phase II go ahead for the ILC has been postponed until September, 1966. It was originally to have been given in January. Martin is still pushing for early approval of the DIMAC concept so that procurement can start. My contacts in SSD tell me there will be no go ahead until the results from our study are available.

R E Blue

R. E. Blue

REB/cfc

cc: R. W. Swanson

MO 2-8416-9

ACRONYMS FOR DIMAC

AGE	Aerospace Ground Equipment
CST	Combined Systems Test
DIMAC	Data Integration Malfunction Analysis Computer
DRS	Data Recording Set
AFETR	Eastern Test Range
ILC	Initial Launch Capability
OCALA	On-line Computer Analysis in Launch Assistance
OGE	Operating Ground Equipment
OTTS	OGE Test Tool Set
PCM	Pulse Code Modulation
VAB	Vehicle Assembly Building
VAFB	Vandenberg Air Force Base
VECOS	Vehicle Checkout Set
AFWTR	Western Test Range

Customer/Prospect Name (1) MARTIN-DENVER, Littleton, Colo. 4/19-20/66 (15)

Individual(s) contacted (16) See below (59)

Your Name (60) W. Gourlay, Jr. (70) Date (71) April 22, 1966 (76)

Summary of Facts Covered:

1. ATTENDEES: R. Winckler, F. O'Rourke, W. Gourlay, Jr., K. Gajewski, B. Pennington, et al

2. BACKGROUND: B. Pennington, K. Gunderson and other Martin personnel have reviewed this group's preliminary specification for the Titan IIIC checkout system. The single copy in their possession was retrieved at this meeting.

3. SIGNIFICANT ITEMS:

a. Those Martin personnel present exhibited a positive interest in the ROS concept as described by K. Gajewski.

b. Martin is now considering an initial factory-installed system to include active command/control functions. This is a departure from their previous idea of a simpler monitor and diagnostic complex.

c. The PCM input rates are now expected to be 384 kbits/sec. rather than the 350 kb/sec. previously expected. Data synchronization would be provided by Martin.

d. It was reaffirmed that the competitive cost comparisons would be made on the total system price (i.e., Martin-supplied equipment + vendor-supplied equipment).

e. Martin expressed no major disagreement with our preliminary basic system configuration. They did, however, indicate that the initial purchased system would not include all the proposed equipment which can be provided as an expanded capability. However, this is in agreement with our basic modular approach and should not be interpreted as detrimental.

f. USAF approval of the RPD is expected by Martin in the next two weeks. Funding for the RFP apparently will not be available until September, 1966, although the RFP would be issued sooner. The RPD as submitted by Martin is only for installation at the Denver facility, and will not, unless modified by USAF, include a system for Vandenberg AFB.

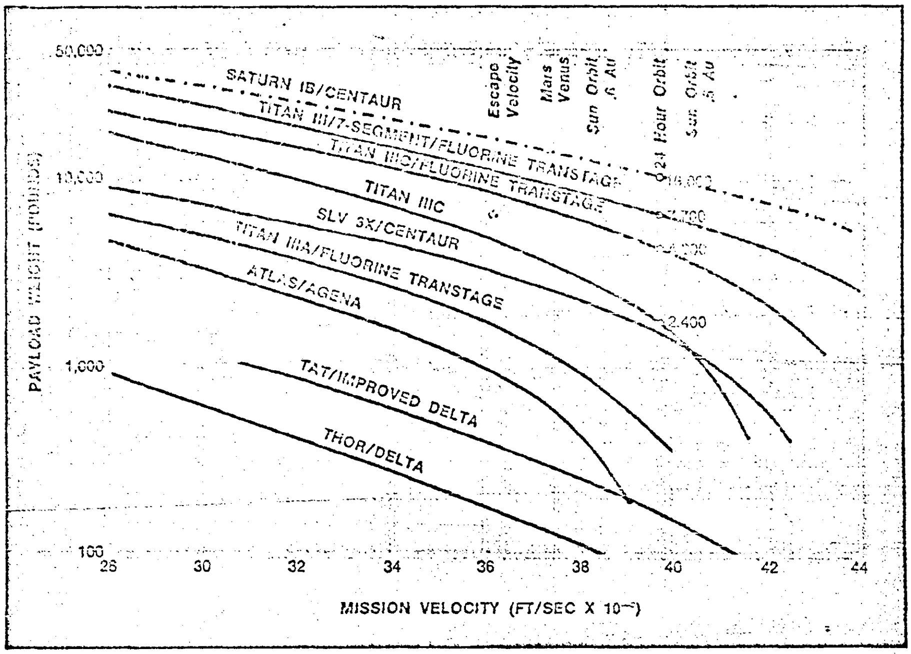
4. GENERAL COMMENTS: B. Pennington indicated a Martin willingness to provide the comparator front end in the event a vendor could not. The capability of the ROS to do this job was explained, as well as its capability to tag all data. Martin intends to provide the system/ground station interface.

W. Gourlay Jr

W. Gourlay, Jr.

WG:jh

cc: C. B. Brown
K. Gajewski
W. B. Gibson
R. Hippe
J. Klotz
F. Mutz
W. Peavey, Bethesda
B. Reynolds



Comparison of possible launch vehicle combinations using available systems and fluorinated Transtage. Scout is not shown. The Air Force is also interested in the Minuteman ICBM first stage as a launch vehicle. There is a good possibility that contracts will be let by the Air Force for investigations of the cost effectiveness of the Minuteman first stage as Minuteman I's are phased out of the weapons inventory. Funding possibilities for such an effort look good, since the alternatives for the weapon's stage I are destruction, planned storage or use as a boost vehicle.

Launch Vehicles

Building Blocks Reaching Payoff Stage

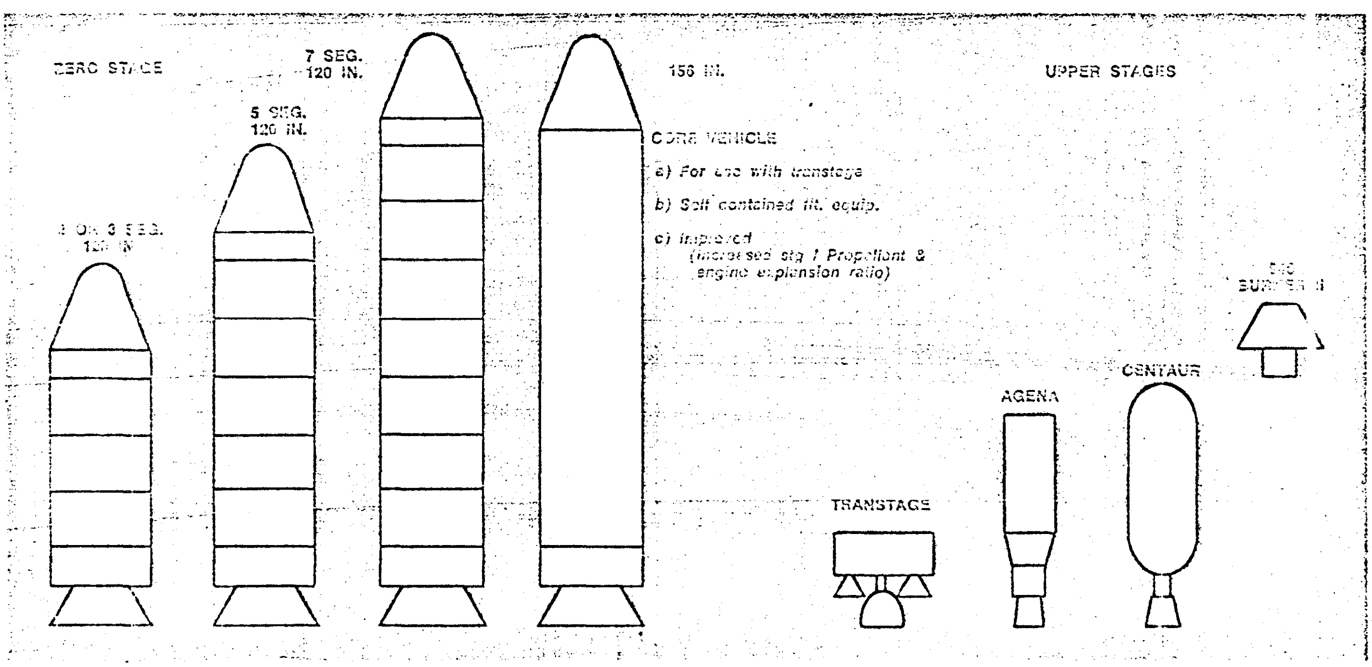
by John F. Judge

WASHINGTON—The military launch vehicle stable is full. Every mission now under serious consideration can be fulfilled by existing and developmental propulsion systems.

Discussions with Department of Defense, Air Force and industry experts indicate that there is general agreement among all on the total lack of a requirement for an all-new launch vehicle system within the next five years—and few signs that such a requirement will emerge in the following five years.

The building-block approach taken by DOD over the past years has resulted in an almost fantastic series of possible upper- and lower-stage combinations, which can respond equally

Combinations within the state of the art in the Titan III family and other upper-stage systems. So-called "big-core" element is not included in the defined core alternates shown. These configurations are valid, but only the Titan III-C combination is currently funded. Other elements are funded as separate items by the military or NASA.



well for near-Earth, equatorial, synchronous and deep-space military missions. The major hitch is that not all of these propulsion systems are operational. The full stable will really come into being only if current programs are pursued with adequate funds.

The military and NASA cooperate at both the working and management levels in booster and launch vehicle requirements and technology.

New cryogenics coming—New propulsion concepts in large cryogenic chemical systems are being funded by the Air Force in the advanced development category with a Fiscal Year 1966 allocation of $8 million and a proposed FY '67 funding level of $6 million.

Known as the High-Performance Cryogenic Rocket Technology Program, the effort involves two firms. Rocketdyne Div. of North American Aviation is investigating a 1,500-psi toroidal combustion chamber together with a chamber tap-off turbine drive and an altitude-compensating aerospike-type nozzle.

Pratt & Whitney Div. of United Aircraft is researching a 3,000-psi transpiration-cooled combustion chamber, together with a topping cycle turbine drive combined with high-expansion-ratio bell-type nozzles.

The propellants in both cases are hydrogen and oxygen. Air Force intent is to develop the technology necessary for the engineering development of flight-weight engines in the 100,000- to 500,000-lb.-thrust class.

The engine modules ultimately developed will be used either as single, high-energy upper-stage powerplants or in a variety of multiple-engine clusters to propel reusable launch vehicles.

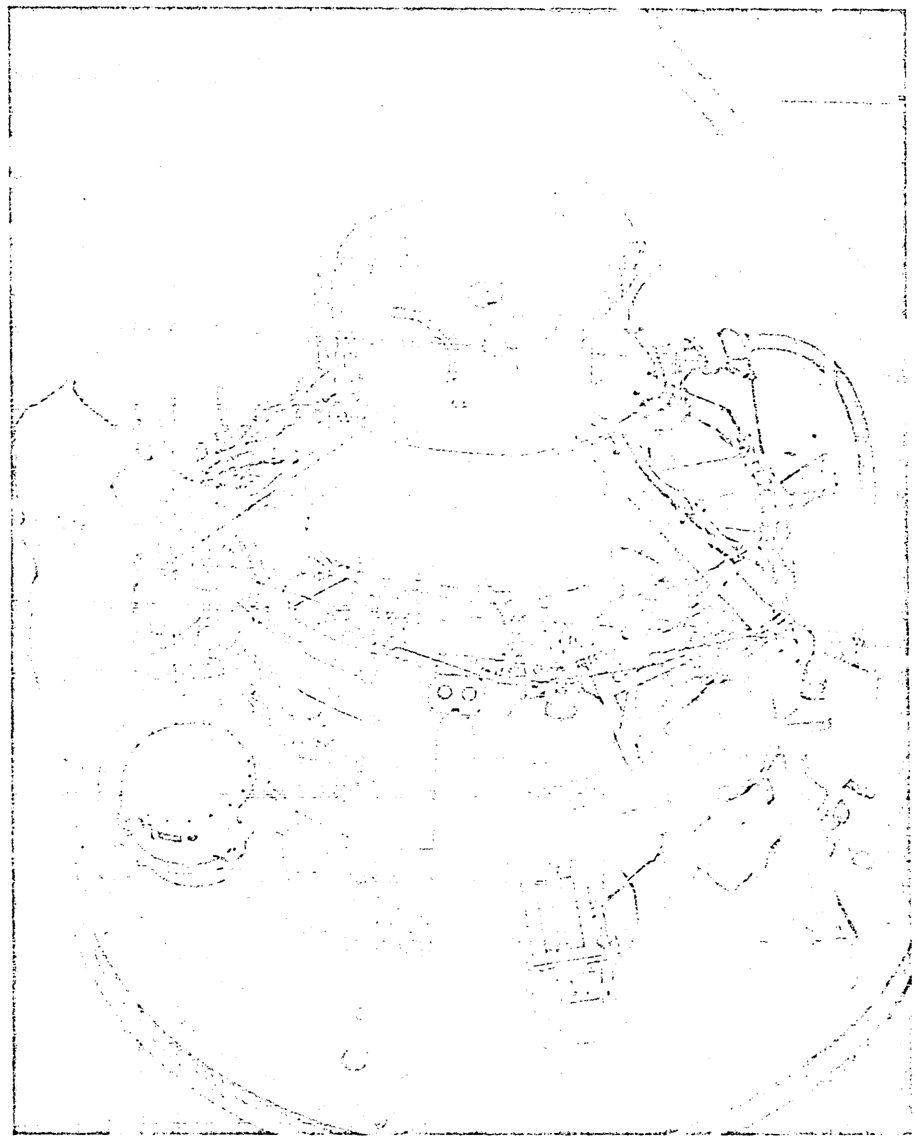
Just how far in the future this ultimate use will be can be understood by the reference to reusable launch vehicles. Most experts consider these to be essentially out of sight.

Flight-weight nuclear reactor systems—now being developed by NASA for its own propulsion missions—are not seen as likely candidates for military space missions, at least not those missions now on the planning boards.

The *Thor/Ablestar, Thor/Agena D*, thrust-augmented *Thor*, and the *Atlas/Agena D* are all proven vehicles and handle almost all current military space launches. Most of these vehicles have a healthy future. *Scout* is a NASA-developed booster used by the Air Force for specific missions.

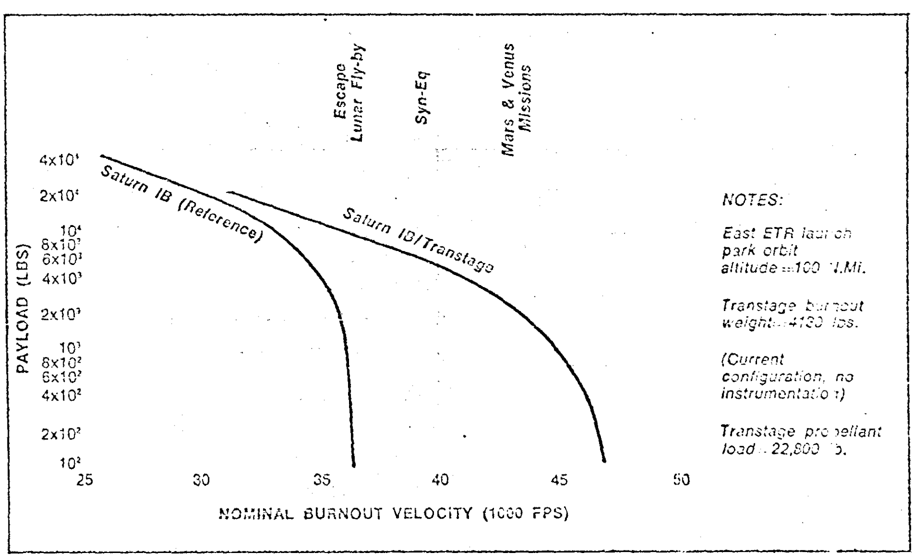
The building-block approach essentially involves the next generation of vehicles—based on the *Titan* vehicle and covering the large-solid zero stages as well as a combination of upper stages.

The Titans—*The Titan III-C*, a *Titan II* storable liquid core slung between two five-segment, 120-in., 1-mil-



Boeing's Burner II upper stage (Program 946), which is being considered by the Air Force for use in combinations of current propulsion systems proposed for deep-space missions. Burner II might also be used in launches into low-Earth orbit. Burner II has not yet been launch-tested.

Possible applications of the Transtage unit in combination with NASA's Saturn IB based on a Martin Co. performance projection.



lion-lb.-thrust solids, topped by a *Titan II* second stage and then the versatile Transtage, is now in flight testing. It is the first in the family since the *Titan III-A* (*Titan III-C* core without solid zero stage) which, although flown, is considered a building block rather than a launch vehicle in its own right.

Transtage troubles in past launches have been analyzed and Air Force experts are convinced there are no design difficulties. Thus, the next *Titan III-C* launch has been delayed for about three months while an intensive checkout procedure is pursued.

The next two *Titan III*-type vehicles about to enter active development are the seven-segment 120-in.-dia. solid configuration chosen as the *Manned Orbiting Laboratory* launch vehicle, and a two- or three-segment 120-in.-solid zero-stage version for intermediate payloads. There is little doubt about its becoming operational.

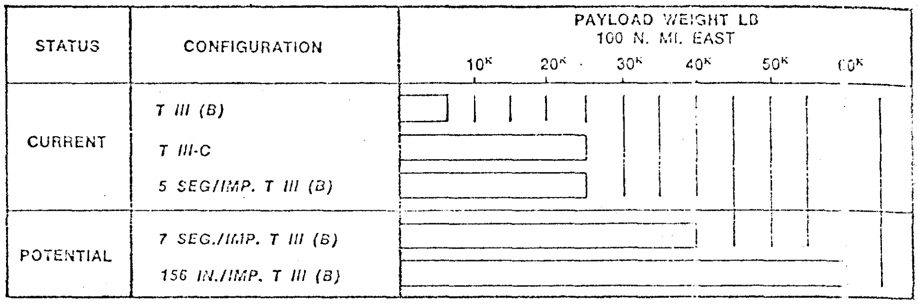
The *Titan* core used in these vehicles is essentially the same as the *Titan II*. An improvement program is now being initiated, however, to increase the nozzle expansion ratio for altitude starts, improve the injector design, and increase propellant capacity. These changes will be in the first stage and will result in significant performance increases at a relatively negligible cost. The current *Titan III-C* development cost is in the $900-million area and the improvements amount to only a small fraction of this.

Mission analyses performed by the Martin Co., developer of the basic *Titan* vehicle, indicate that many military missions can be performed by using various segmented 120-in.-solid and 156-in.-solid zero stages combined with three core configurations topped by Transtage, *Centaur* or *Agena* propulsion systems. The studies also include using the Boeing *Burner II* (Program 946) as a fourth stage (see charts).

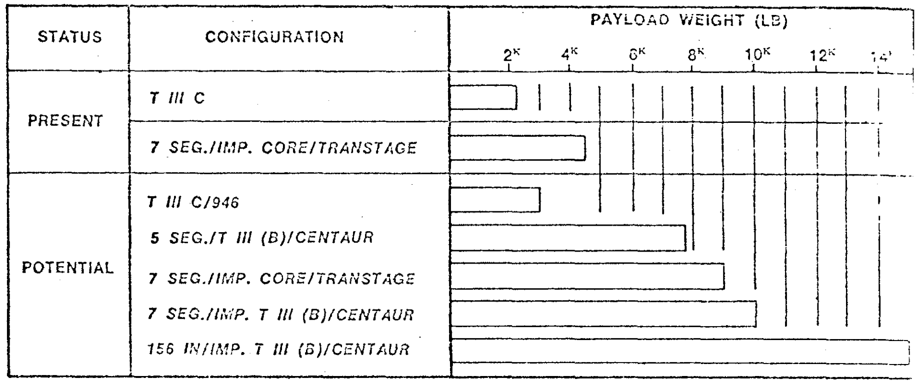
Upper-stage combinations—Martin officials are convinced that the Transtage can be coupled to current fluorine technology resulting in a new high-energy upper stage. The fluorine technology has been under development by Air Force and NASA for several years. Martin experts say it would be well worthwhile to start narrowing this effort to focus on such a vehicle as the Transtage.

Calculated performance levels involving all these combinations are comparatively shown in the accompaning charts..

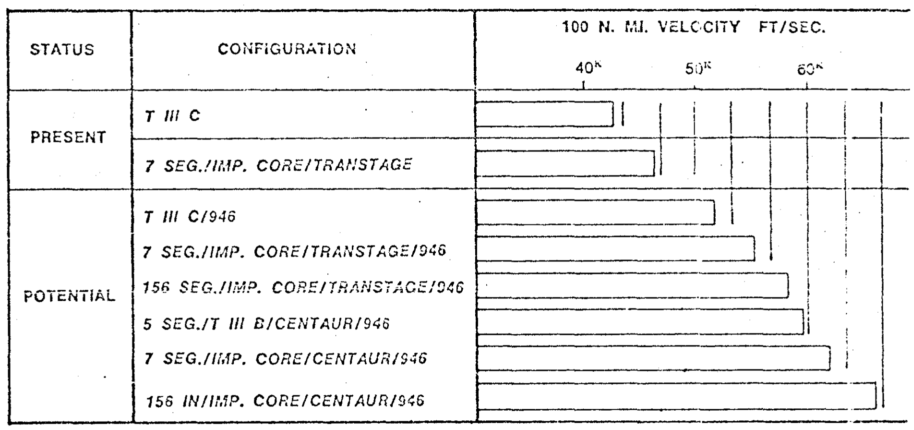
In early *Titan III* planning, both *Centaur* and *Agena* upper stages were considered. The reasons for not actively pursuing these avenues were largely economic, although it was determined that both upper stages are feasible in combination with the current *Titan III-C* minus the Transtage. However, there



Low-Earth-orbit launch vehicle building-block combinations as pictured by Martin Co. planners. The Boeing Burner II stage could be added, as well as a Transtage, as propulsive elements.



Configurations within the building block possibilities designed to handle synchronous equatorial-orbit missions. The number 946 is that assigned to the Boeing Burner II.



Deep-space missions within the reach of possible building-block combinations. Again, the 946 refers to the Burner II stage. All figures and combinations are Martin Co. projections based on performance values developed within the propulsion systems that exist today The Transtage fluorine uprating is not part of this deep-space projection.

are no definite programs involving any of these combinations other than the current *Titan III-C*—the lower-segmented version, and the seven-segment configurations.

But *Centaur* is being developed and is flying. *Agena* is a proven upper stage and *Burner II* is being designed and built by Boeing. Lockheed is now approaching the Air Force with plans to uprate the *Agena* and move it into the *Titan* building-block series.

The 156-in. solid rocket is now a technology program—subsisting on a DOD-imposed funding level of some $2 million per year. At least this is the level planned for the next fiscal year.

There are no stated missions for the 156-in. system as a strap-on. The current funding level is deemed too low even for a technology program by everybody except DOD. In spite of its apparent lack of mission, the big solid still has a strong potential for the *Titan II* program and this application is most likely to be the one that moves it out of the doldrums.

The constant harping on missions as justification for the development of any of the launch vehicle combinations cited often obscures the cost factor—and this is a real factor. Air Force and industry are fully aware of this and every concept is now being approached more on a cost basis rather than any assumption of possible missions.

CUSTOMER NAME:	Philco, WDL 3875 Fabian Way Palo Alto, California
REGION:	Western
DISTRICT:	16
BRANCH:	San Jose
BRANCH MANAGER:	E. H. Dohrmann
MARKETING MANAGER:	J. Doyle
SALESMAN:	V. Ziogas R. Clark
SYSTEMS ENGINEER:	I. Wentzien

A. Customer Organization

1. Personnel -- All of the following personnel are in the project management office.

D. M. Rowell
J. L. Abbott
S. W. Teicher
J. Corsiglia
W. C. Slagle
T. Easley

Individual titles are unknown. Initial contact was made at the request of S. Teicher who recently returned to WDL from Tech. Rep. Division of Philco. In his position in Tech. Rep., Teicher ordered an IBM 1130 to replace a GE 225 at El Centro Parachute Test Range.

J. Abbott was the project engineer who recommended a CDC 3100 for the operations center at Pt. Magoo. This decision was reversed by Navy personnel and a 360/40 is presently being installed at this location.

B. Background

1. Philco WDL presently has the O & M contract on five of the eight remote sites of the SCF and I & C at all sites. Presumably these facilities will be used to support MOL.

   WDL has also been active in support of NASA in Houston.

   From an equipment standpoint Philco makes equipment for both the vehicles and satellite tracking equipment.

2. There is presently no IBM equipment (outside of U/R) installed in WDL. The computer presently used by the facility is a Philco 212.

C. Current Status

1. Philco is interested in MOL because of their connection with SCF. No RFPs will be released by Philco and as a result all contacts with this customer have been advisory in nature, i.e., 360/44, 360/67 presentations.

   The hardware has been well received by Philco personnel, particularly the 360/67 and its organization. The price on this system did have a detremental effect on their attitude however.

D. Problem Areas

Points of discussion that have come up in our talks with Philco that may indicate hardware problems:

1) Availability of a channel that would allow external addressing of memory with identifying bits from the telemetry work.

2) Shared memory is desired although it isn't considered necessary.

3) 360 hardware costs may be high.

E. IBM Strategy

1. Sales Action Program

Continue our advisory program. Provide any possible coordination between Philco WDL and MOL Project Office. Philco is primarily interested in the following phases of the remote site facilities:

a. Software
b. Integration
c. Operation

2. Technical Help Required

None at present. Future demands may come in details of satellite control and data handling that may require assistance from MOL Project Office.

3. IBM System Design

No formalized design. A dual 360/44 system has been suggested to Philco.

G. Competition

1. Primary competition is CDC. (Probably 3300.) Philco has not eliminated the possibility of the sole source procurement for the remote site hardware. There has been no discussion by Philco personnel of advantages or disadvantages of IBM vs CDC.

MOL STANDARDIZED CALL/TRIP REPORT (IBM CONFIDENTIAL)

Customer/Prospect Name (1) Philco Corporation - Western Development Lab (15)

Individual(s) contacted (16) Sheldon Tiecher and Jack Corsiglil (59)

Your name (60) W. B. Gibson (70) Date (71) March 31, 1966 (76)
T. M. Charbonneau

Summary of Facts Covered:

This visit was made in support of the San Jose Branch Office. Branch attendees were:

Vince Ziogas
Irv Wentzien
Rich Clark
John Doyle

The customer was interested in securing technical information regarding the 360 Mod. 44. This information was required in great detail. Philco, represented by Sheldon Tiecher, was only interested in discussing equipment requirements at Remote Sites. It is interesting to note that they at no time discussed Satellite Tracking Center equipment with any IBM personnel, indicating that:

1. They do not believe that this will be in the RFP, or

2. They believe someone other than IBM has the business.

Philco's prime comments regarding Model 44's were:

1. It appears to be the best IBM system for the job.

2. They are concerned about the lack of an IBM-furnished multi-programming monitor and were vocal in pointing out that other competitors supplied this.

3. In equipment configuration, they asked us if price included significant amounts of magnetic tape and card/printer Input/Output. When queried on the need for this, they stated that the administrative work at the Sites required this equipment.

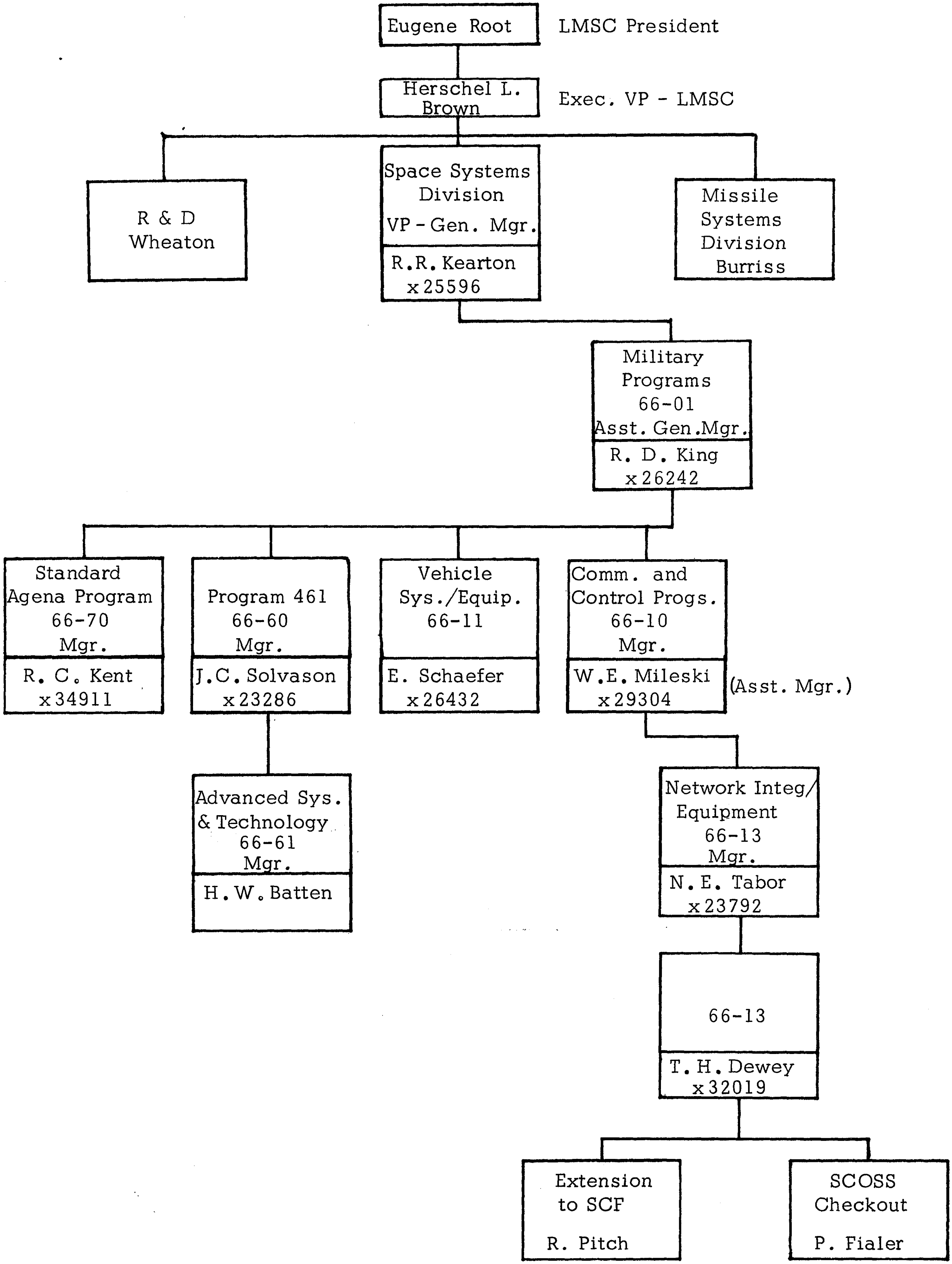
Follow-up calls will be made by the Branch to supply additional technical assistance.

By copy of this report, I am asking Charlie Brown to work with Bob Krause and Jim Selfridge to determine the rental of the installed administrative equipment at each Remote Site and to see that this is adequately considered in our proposal.

W. B. Gibson

cc: C. B. Brown, J. J. Doyle
R. G. Krause, J. J. Selfridge

CUSTOMER NAME:	Lockheed Missiles and Space Co. P. O. Box 504, Sunnyvale, Calif. Telephone: 742-7151
REGION:	Western
DISTRICT	16
BRANCH:	San Jose
BRANCH MANAGER:	E. H. Dohrmann
ACCT. MKTG. MANAGER:	W. G. Burke
ACCT. REPRESENTATIVES:	C. R. Springer J. L. Spivack
FSD REPRESENTATIVES:	A. Peckar John Bridges G. McClure R. Strayer


Eugene Root
LMSC President
Herschel L. Brown
Exec. VP - LMSC
R & D Wheaton
Space Systems Division VP - Gen. Mgr.
R.R. Kearton x 25596
Missile Systems Division Burriss
Military Programs 66-01 Asst. Gen.Mgr.
R. D. King x 26242
Standard Agena Program 66-70 Mgr.
R. C. Kent x 34911
Program 461 66-60 Mgr.
J.C. Solvason x 23286
Vehicle Sys./Equip. 66-11
E. Schaefer x 26432
Comm. and Control Progs. 66-10 Mgr.
W.E. Mileski x 29304
(Asst. Mgr.)
Advanced Sys. & Technology 66-61 Mgr.
H.W. Batten
Network Integ/ Equipment 66-13 Mgr.
N. E. Tabor x 23792
66-13
T. H. Dewey x 32019
Extension to SCF
R. Pitch
SCOSS Checkout
P. Fialer

B.1 Historical Background - Lockheed MSC role in the MOL Project and related IBM marketing effort -

a. Primary MOL Proposal Effort

This effort started September 1964 with a nucleus of key LMSC people and grew to a peak level of over 600 in June 1965. After it was announced that Douglas had won the competition, this organization quickly disbanded except for a small group seeking to market MOL technology to NASA.

Contacts: S. Edwards
R. B. Gangstad
H. Breen
B. Bayuk
E. Lennon

IBM calls on the customer started early in the program, these calls and presentations were made to (1) develop contacts, (2) market standard computer equipment for ground data processing, and (3) market "off the shelf" airborne type computers via FSD. (This third effort was in cooperation with LMSC requests but was necessarily restricted since FSD had already teamed with Douglas Aircraft on a competitive proposal.)

b. MOL Ground Data Processing Proposal

Contacts: J. Carrol
W. Reinhold
R. L. Richman

As a side effort to the primary proposal, a group within Lockheed went after an expansion to the Satellite Control Facility (Sunnyvale) to support MOL. Cooperative effort in this area from January 1965 led to a presentation in March 1965 involving a duplexed 360/50 configuration with graphics and 1800's. Lockheed liked this configuration and went to the Air Force with it. The Air Force eventually directed that any extensions in capability to the SCF (as well as the facility at Cape Kennedy) would be in the CDC-3600 area. At this point this effort was discontinued by Lockheed.

c. Command and Control Proposal

Contacts: D. Harris
J. Hooper
D. McClinton
T. Dewey
M. Feldstein

In mid-August 1965, a large unsolicited proposal effort was underway (Lockheed proprietary) to entirely revise the Satellite Control Facility (SCF) at Sunnyvale. As part of this effort, a large time sharing complex was configured and priced by mid-September for Lockheed.

While the computing configuration was large ($265.000 rental, $11.8 million purchase) its cost was only a small part of the total cost of the LMSC system proposal. The configuration included (3) 360/67, (5) 2065, 40 (2250 II), 40 (2260), 2280, drums, disks, 2314's and other supporting I/O equipment. Implementation was tentatively slated to take place starting between late 1966 and 1970.

This project, in this particular context, has been in a dormant status since Lockheed's presentations to the USAF. The effort to revise SCF has not disappeared; however, it has taken some new forms over the past few months as described below in C.2.

d. From a strategy and sensitivity standpoint, it is also important to consider the historical background of the 461 Project which precedes the MOL project by several years and is in some ways related. This is a classified project on which several studies have been made recently involving large System/360 computer systems.

B.2 Installed IBM Equipment

The following systems are now installed:

Three IBM 7094's; two of which are purchased
Two IBM 1410
Two IBM 1401
Three IBM 360/30

Several other IBM 360's (including a Model 40 and 50) are planned for installation in 1966 replacing the two 1410's and last 1401 as well as discontinuance of the rental 7094 system.

C. CURRENT STATUS

C.1 No formal proposals are outstanding at this time; however the most recent configuration for the 461 Project is very active now. Iterations with the customer are currently underway leading to a firm proposal.

C.2 Other Active Projects

a. Interim Extension to SCF and SCOSS Project

Contacts:		
	T. Dewey	Project Manager
	P. Failer	SCOSS
	R. Pitch	Extension to SCF
	J. Baker	Extension to SCF
	D. McClinton	C & C
	V. Olsen	Aerospace Corporation

These two projects are related to Item B.1 (c) described above.

Extension to SCF - Lockheed has the job of integrating IBM 2250 displays into the existing Satellite Control Facility (Sunnyvale). Local sales effort has been in the form of calls and presentations relating to System/360, the IBM 2250 displays, graphic film units, and physical planning. The 2250 display was demonstrated to Lockheed at the FJCC at the same time as the Aerospace Corporation and USAF representatives. Information has been provided locally on tying an IBM 2250 to a CDC 160 computer.

This effort is essentially directed from the Aerospace Corporation and the equipment will be ordered there. Therefore, local IBM effort is supportive in nature to the principal thrust taking place at the Aerospace Corporation account as coördinated by the IBM MOL Project group.

SCOSS , This project is entirely of Lockheed origin and is in a conceptual stage at this time. The purpose of the SCOSS project is to design and implement a Satellite Checkout System here at Sunnyvale for SCF. This project does hold some potential for an On-site System/360 with graphic data processing equipment. Equipment would be ordered locally.

b. VAFB Computer Facility

A new effort is being started now to propose a redesigned Vandenberg AFB facility. This effort is by the LMSC personnel at Vandenberg as assisted by the Sunnyvale Information Processing Organization (A. Cordvan, W. Grundherr.) This complex will involve about 6-8 computers and will probably be 8-10 times as powerful as the existing facility. This checkout and tracking facility will support MOL shots as well as the other Usual VAFB test activity. Completion of the proposal effort will be in about March 1966 with equipment delivery about 4Q66.

1. CONTRACT STATUS

   a. Lockheed has I & C and O & M contracts on the Satellite Test Annex which includes the bird buffer area. The O & M contract will last to 1967. The I & C contract(s) are being added to by such efforts as the Extended SCF Capability and SCOSS at this time, but their exact duration is not yet known.

   b. Verification of Contract Status Summary

Remote Sites	Kodiak	Indian Ocean	New Hamp-shire	Classi-fied	VAFB	Hawaii	Satellite Tracking Center & BB
I & C	Philco	Philco	Philco	Philco	Philco	Philco	LMSC
O & M	LMSC	Philco	Philco	Philco	LMSC	LMSC	LMSC

2. Dollar value of Lockheed's contract is considered LMSC proprietary information. There are several contracts however and two are thought to be in excess of 50 million exclusive of equipment. Total contracts are believed to be well in excess of 100 million dollars.

3. The Air Force relies heavily on Lockheed for technical help but LMSC is aware that they are just contracting labor and have a fairly unsatisfying type of subordinate job. Unfortunately for LMSC, the local Air Force people have limited influence in new system designs and equipment selection.

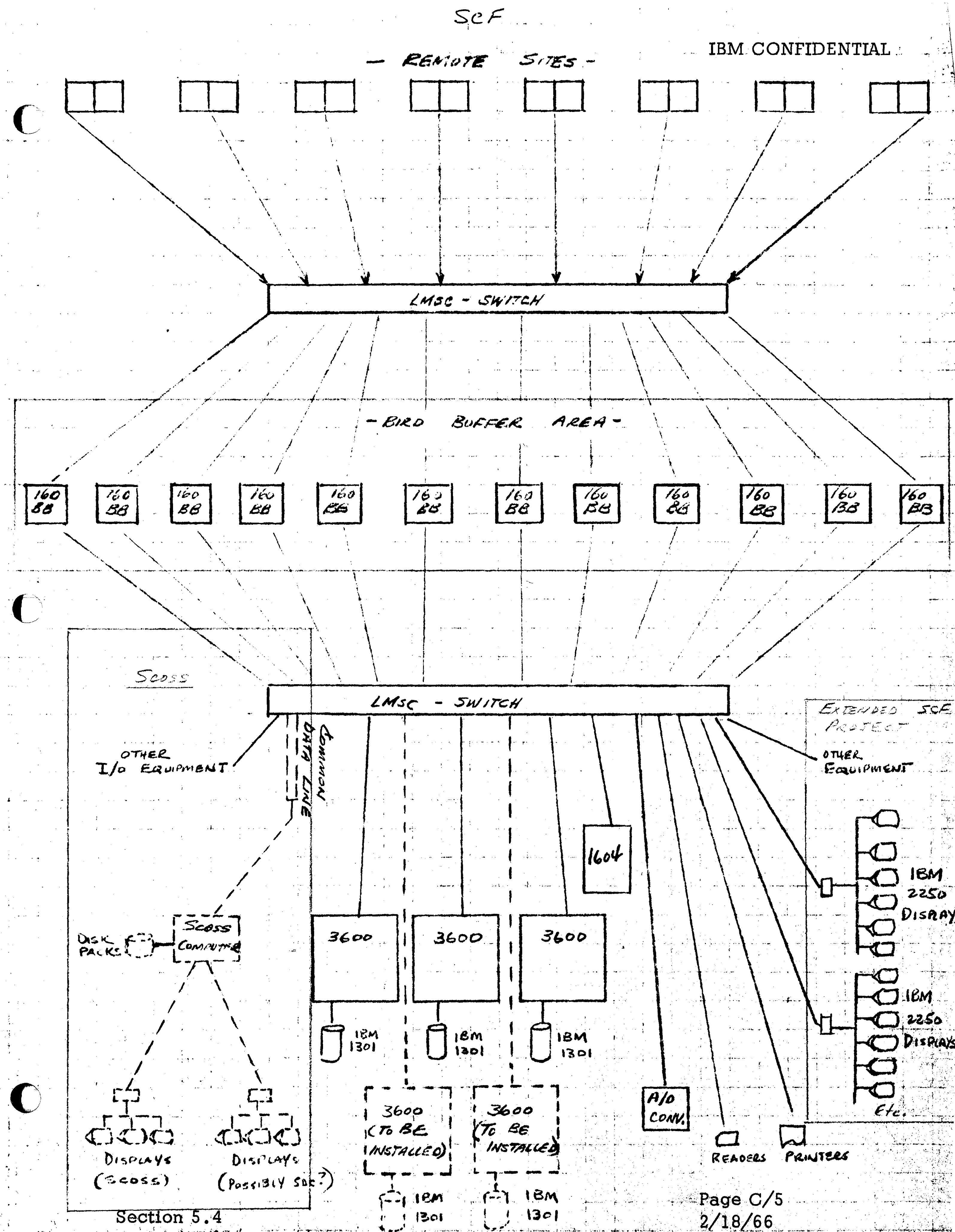
4. Lockheed realizes that its goal of more systems integration business in this area (as well as its present business) is threatened by the possibility that the Air Force will furnish more large CDC computers (from 3300s to 6400/6600) as GFE. The best approach for Lockheed seems to be to promote some new business in this area by improving capability with new system designs in limited areas and gradually expanding them from that point. SCOSS is the prime example of this apparent strategy and is described in (5). The upgrading of the bird buffer area is another area and LMSC already has people at work on this area even though they refuse to discuss it openly.

5. SCOSS

This project is entirely of Lockheed origin and the plan has been submitted to the Air Force. Contract go ahead expected by 2/15 - 3/15/66. Equipment will be ordered by 2 to 3 months with installation in 3 - 4 Q 1966. Equipment potential ranges from 1 to 3 displays possibly with a small S/360 with files.

SCOSS is a systems checkout, control, status, and scheduling system for the entire STC data system. Lockheed will furnish the checkout, control, and switching part of it and will put this system together with the existent SDC schedule and status information from the common data pool. Data for the data system checkout and control will be extracted from all parts of the system via any designated 160A in the bird buffer area. All computers would be tapped for this type of information. The information from SCOSS would be used to increase the efficiency and management control over the STC data system. It is a perfect entry point for future effort on the bird buffer area. (See Figure 1).

6. Mellonics is not included in all discussions by LMSC. These people are partitioned-off in the application area. For example, they are being told to look at their programming chore as being largely machine independent.


SCF
— REMOTE SITES —
LMSC - SWITCH
- BIRD BUFFER AREA -
160 BB
160 BB
160 BB
160 BB
160 BB
160 BB
160 BB
160 BB
160 BB
160 BB
160 BB
160 BB
SCOSS
LMSC - SWITCH
COMMON DATA LINE
OTHER I/O EQUIPMENT
SCOSS COMPUTER
DISK PACKS
DISPLAYS (SCOSS)
DISPLAYS (POSSIBLY SDC?)
3600
3600
3600
IBM 1301
IBM 1301
IBM 1301
3600 (TO BE INSTALLED)
3600 (TO BE INSTALLED)
IBM 1301
IBM 1301
1604
A/D CONV.
READERS
PRINTERS
EXTENDED SCF PROJECT
OTHER EQUIPMENT
IBM 2250 DISPLAYS
IBM 2250 DISPLAYS
Etc.

D. PROBLEM AREAS

D.1 The principal problem at this point seems to be hardware delivery, particularly of 360/65 and 44's and 2250 displays. Special interface equipment could also cause delivery problems.

D.2 The specialized programming requirements of these projects and the intentions of the customer or FSD to supply certain real time control programs makes a definitive estimation of O/S 360 requirements difficult. It does seem clear, however, that on-schedule availability of parts of O/S 360 along with graphic support will be important to our selling efforts. More investigation is needed in this area, along with consideration for supporting shared memory for 360/65 and/or possibly support for bulk core as an I/O device.

D.3 Special hardware design yielding significant cost advantages should be studied further such as combination of 2701 data adapters (some of which will have special performance characteristics), special PCM interfaces, and switching equipment.

E. IBM STRATEGY

a. Interim Extension to Satellite Control Facility

Currently providing local support for the work Lockheed is doing for Aerospace Corporation account. (Ref. C.2 (a))

b. SCOSS

Actively assisting this area. At this time nocompetitive activity yet identified.

c. VAFB Proposal

Additional information will be gathered on this project in the next few weeks which will permit the development of a specific plan of action. The configuration developed locally will be closely coordinated with the IBM MOL Project in order to develop the strongest possible proposal.

G. COMPETITION

The principal competition for this work is expected from CDC and UNIVAC. For the Extension to the SCF, Vandenberg Proposal and SCOSS Project, CDC appears to be a slightly stronger competitor than UNIVAC. The computers will probably be the CDC 6400 and 3100. CDC has its own graphic displays and alphameric displays along with a Data Display Recorder. In the case of UNIVAC, the 1108-1 and 1108-II will probably be used for the larger machines with 490 computer used for front end work. UNIVAC has currently been making presentations locally with IDI (Information Displays, Incorporated) which is a change from its previous reliance on DEC (PDP) displays.

Call on LMSC February 2, 1966

Planned Agenda

1. LMSC Attendees
   - J. V. Plummer - Vice President and Assistant General Manager
   - R. C. Kent - Assistant General Manager, Military Programs
   - N. Tabor - Manager Network Integration
   - Tom Dewey - Senior Staff Engineer
   - Walt Schuman - Project Marketing to SCF

2. Topics:

   A. Introduction

   B. Mutual Interest in SCF
      - Computing RFP
      - Systems RFP
      - What Does LMSC Think These Are

   C. Potential Mutual Interests, LMSC and IBM

   D. LMSC Current Posture in SCF
      - O & M
      - I & C

   E. Working Arrangement prior to RFP
      - Not formal until RFP structure is firm
      - Determine Std and Special Hardware REQ
      - Make a mock proposal
      - Free interchange of information - but keep proprietory

   F. Mellonics Influence

   G. LMSC - IBM
      - Other extension - e.g. WTR

   H. Conclude with Specific Plan for Action

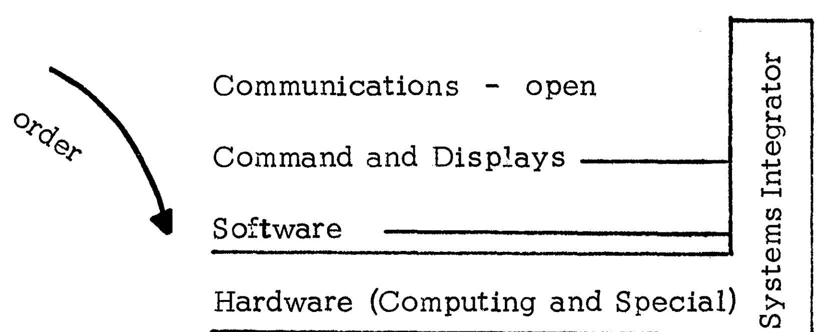
February 3, 1966

DEBRIEF ON LMSC CALL OF FEBRUARY 2, 1966

The attendees are as given in the planned agenda, which was followed almost explicitly.

NOTES - Plummer gave rundown on LMSC organization - showing Kent being in charge of Special Projects. Hamlin and Kent could be considered as counterparts. I deem Kent to be good leading performer to whom Plummer delegates project responsibility after policy level questions are settled. There is no doubt but that LMSC recognizes that their business interests would be enhanced by claiming working relationship with IBM. I deem they are reluctant to commit to work exclusively with IBM at this time. Kent seems eager to cooperate. LMSC is, however, quite desirous to be systems integrator and to be in charge of systems engineering.

Tabor then conducted briefing regarding STC (and SCF). He gave expected contract structure as:



We covered present LMSC "R & D" work scopes as:

A.
1. Integration (augment to Aerospace)
2. Detailed systems engineering, advanced planning, configuration control, i.e. 375
3. Installation and Checkout
4. Operations and Maintenance

B.
Associate Contractor to buy or build STC equipments

In conversation he mentioned misue of communications gear as to why Integration contractor will get into this area and that system upgrade will use 4800 bits/sec.facilities.

We discussed WTR FEC contract area. Lockheed Electronics will bid supported by LMSC and Lockheed Field Service.

They expressed great interest in TMCC and talked of knowing Colonel Newton and Greede (SP).

Dewey mentioned security problem in Communications area.

We spent some time describing function and interests of FSD to allay possible LMSC concern on our rôle. We explained that our interest extended only to assuring that computing systems - and first functional level of connecting subsystems were IBM responsibilities - perhaps with LMSC quality control or system assurance rôle.

Schuman - is not a strong leader.
Dewey is important from technical and history relationship to STC.
Tabor seems competent - his participation is hard to estimate.

They discussed money limitations and indicated Control Center extension at Sunnyvale.

Tabor talked of organizations (WTR and SCF) competition for money and fear of SPO dictates.

Tabor discussed short-term expansion plan and long-term expansion plan - the latter being the final Control Center configuration.

LMSC considers STC and RTS being inter-related and contractually together. We didn't probe this because of Philco vs. LMSC contractual sensitivity.

Their discussion on Mellonics did not impress me that they considered Mellonics critical in system implementation performance. They acknowledged Mellonics software competence.

Tabor is concerned on 375 specification requirements - he discussed handicap of complying wherein rental devices are in the system.

They did not provide any information on Dispay (2250) implementation.

We agreed to further consideration by both Companies.

We discussed further investigation and thinking. Plummer mentioned their laying down their work scope interest which could then be compared with ours in the next meeting, scheduled for February 11, 1966.

We mentioned and briefly discussed checkout systems and our contacts with Martin and Douglas.

In departing, I mentioned mission planning and short turnaround for contingencies.

J. E. Hamlin

JEH:jh

MOL STANDARDIZED CALL/TRIP REPORT

Customer/Prospect Name (1) Lockheed Missiles and Space Corporation (15)

Individual(s) contacted (16) See Below (59)

Your Name (60) M. B. Needle (70) Date (71) 4/27/66 (76)

Summary of Facts Covered:

On April 26, a 3-hour technical presentation was made to the following people:

P. A. Fialer
S. K. Lynch (Mellonics)
D. M. Paige
K. H. Powell
A. F. Menter
R. E. Anglim
C. K. Nakata
J. T. Carroll
T. Dewey
C. R. Springer (IBM)

In addition, there was some discussion with T. Dewey on the Model 44 Shared-Memory design for the RTS.

M. Needle

M. B. Needle

MBN/lr

cc: W. B. Gibson
C. B. Brown
J. J. Selfridge
C. R. Springer, San Jose

AF/CPDC TEST BED AT SDC FOR BB/TS PROGRAM CHECKOUT

160A Main Frame	3	2250	6750	
166-2 Printers	5	690	3450	
169-2 Memories (16K)	8	2000	6000	
167 Card Readers	1	460	460	
603 Tape Drives	12	550	6600	
161 On-Line Typewriter	3	262	786	
162-3 Data Synchronizer	3	600	1800	
Total SDC/CPDC RTS INSTALLATION:			25846	*25,846 **297,874

STC - PERIPHERAL SUPPORT COMPUTERS
(2 - 610A's) - Approximate Figure: *13,064
**310,938

AF/CPDC PERIPHERAL SUPPORT COMPUTERS
(2 - 160A's) - Approximate Figure: *14,000
**324,938

April 5, 1966

TO: J. E. Hamlin

FROM: J. J. Selfridge

IBM CONFIDENTIAL

SUBJECT: IBM Position with Respect to SDC on the AFSCF

The position IBM will take with respect to the Systems Development Corporation on the forthcoming AFSCF Advanced Data System bid and the follow-on contract is:

1. IBM will not compete with SDC but will develop a plan explaining our method of operation and relationship with SDC in their role as Software Integration Contractor for use in the proposal.

2. IBM will not plan on using them as a subcontractor to assist in the software development. This would present an in-house conflict of interest within SDC relative to their integration role. This latter, I believe, is their viewpoint.

3. IBM will, through calls and briefings, make clear to SDC our position in (1) above.

4. IBM will brief SDC management on our technical design and attempt to obtain their understanding, agreement with and support of that design. Such calls should be limited to those who, we believe, would respect our proprietary data.

This position is based on SDC's past and present role and their future role which are discussed under those headings. Any discussion of SDC's role should consider the method the Air Force uses to control programs in the system. This is known as the Program Milestone System, AFSSD Document 61-47. Briefly, there are 8 Milestone documents:

Milestone 1:	An operational support requirement based on SCF user needs.
Milestone 2:	An operational support plan based on programming support to be provided.
Milestone 3:	A program design specification.
Milestone 4:	Detailed coding specifications and flow charts.
Milestone 5:	Consists of 2 parts: (1) Program decks, assembly listings, etc. (2) Documentation: (a) program description, (b) test specifications, (c) test results, (d) program operating instructions
Milestone 6:	System Test Specifications and Acceptance Criteria
Milestone 7:	System operating procedures
Milestone 8:	Delivered System, deficiencies, interfaces, etc.

As Integration Contractor, SDC performed Milestones 2, 6, 7 and 8. System software contractors, Mellonics, DDI, etc., are responsible for Milestones 3, 4, and 5, and assist on 6, 7 and 8.

SDC's Past and Present Role

Since approximately 1961, SDC has performed a software subsystems integration role for the AFSSD on the AFSCF. They also performed some of the program systems and applications development, production and installation. At the present time SDC has:

- Approximately 220 people working on the AFSCF in the following categories; Administration and technical staff (10); 3600 Programs (50); Requirements Analysis and Design (50); Bird Buffer and Tracking Station Program (40); Computing Facility, Training and Field Support (60).

- Primary responsibility for Milestones 3, 6 and 7--although as can be seen from the immediately preceding point, SDC does development and production work.

- Responsibility for producing control programs and utility system; i.e., SDC is producing a 3600 JOVIAL Compiler and rewrites all CDC supplied software.

- Responsibility for operating the Computer Program Development Facility; and for maintaining all program documentation, specifications, test material, tapes, listings, etc.

- Developed the Program Milestone System for the Air Force.

- A built-in technical facility for support of the AFSCF, the use of which cannot be discussed in this memorandum due to its classified nature.

- An administrative function for AFSSD to maintain status and usage of computing equipment throughout the SCF for billing purposes.

SDC's Future Role

The specific role of SDC cannot be determined at this time because of conflicting attitudes, ambitions, and the absence of clear directives in the Air Force, Aerospace and SDC relative to SDC. It is the intent of SSD that SDC's role be limited to only those factors which are the province of a not-for-profit software contractor. Some AFSSD people would say there isn't anything industry couldn't do working under Aerospace, while others assume that most software should be in-house.

Factors which have been considered in developing the IBM position are:

- SSD let the Orbit/Ephemeric Subsystem contract early this year to Aeroneutronic and DDI with SDC having the integration role. SDC wanted a stronger role.

- AFSSD has stated that the SDC contract will be limited to software integration.

- Some Aerospace management people would like to see SDC out of the system since they present competition to Aerospace.

- SDC may compete for software contracts, although theoretically they would not compete where they had a prior not-for-profit role.

- SDC has supported the Air Force Operations people in the field and has won their respect. Operations would try to keep SDC in the system since SSD and Aerospace are looked on by the field as people who don't stay around to make the system work.

- SDC first and second line management will resist cutting back on their program development and production work; and would prefer a weak software/hardware contractor on the ADS to help maintain their present position.

- SDC has assisted in developing software specifications for the RFP, and SDC will help AFSSD in the evaluation of software designs.

From many discussions I have had with Air Force, Aerospace, SDC and our own people with SDC experience, it is clear that the AF has not arrived at a firm position. I have heard that a directive on the role of not-for-profits is due out soon from Dr. Brown's office. This directive may clarify the position.

I believe that SDC's role cannot change drastically over the next several years, and we should develop plans based on their having a systems integration role.

JJS/jh J. J. Selfridge

cc: C. B. Brown
J. Klotz
R. Krause
G. McClure

MOL PROJECT SECURITY

Some of the material used or generated in the MOL Preproposal effort is classified and is to be kept in the Project Safe when not in use, according to the accepted IBM security procedures.

The project safe must not be left opened when unattended. All documents including working papers must be signed out and signed in. A log book is kept at the safe for this purpose.

No security instructions have been received from the Air Force on this program since we are in a preproposal stage. Therefore, the following in-house rules will be in effect:

1) All working papers that are classified will be kept in a folder or binder that is suitably labeled on front and back.

2) Information taken from a non-IBM document that is on a page labeled with a classification will be considered classified unless it is also found in its entirety in open non-IBM literature.

3) In case of any doubt as to whether an unclassified page is valid, the open literature source should be cited on the information.

4) Information taken from an IBM document that is on a page with a classification will be considered classified unless it is also found in its entirety in open non-IBM literature. If advisable, the source should be cited as in (3) above.

5) Information from an IBM document that is not labeled with a classification, but is known to be classified, will be so classified by the user. The original IBM document in this case will not be reclassified as part of the MOL preproposal effort. If there is an office procedure for these cases, it will be followed.

6) The Air Force will be requested to issue security instructions prior to the commencement of activities by this office in the preparation of an unsolicited proposal or the answering of an RFP.

7) When information is received verbally from such sources as IBM employees, Air Force, Aerospace Corporation and defense contractors, the security classification should also be requested.

8) No discussions of classified MOL material is to be carried on with anyone without ascertaining their clearance and their need to know. The same procedure must be followed when disclosing written materail.

9) All participates should take the deplorable acoustical situation of the office into account when discussing classified matters.

10) The general security regulations regarding blackboards, transmission of data, registry of finished documents, receipts of documents and destruction of data apply in this case.

11) Further information on Security Procedures may be directed to the MOL Project Office.

Suggested Reading List

AIR FORCE REGULATIONS NO. 300-2, 300-3, 300-7.

These documents are concerned with procurement of ADPE equipment in the Air Force.