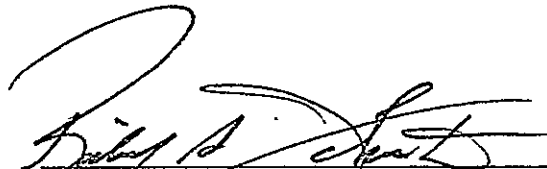



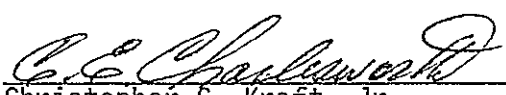
N80-12746

AUTOMATIC DATA PROCESSING EQUIPMENT (ADPE)
ACQUISITION PLAN FOR THE MEDICAL SCIENCES DIVISION

APPROVED BY:


Richard S. Johnston
Director of Space and Life Sciences
8/17/79
Dated


Howard W. Tindall, Jr.
Director of Data Systems and Analysis
8-21-79
Dated

for 
Christopher C. Kraft, Jr.
Director
Lyndon B. Johnson Space Center
9/5/79
Dated

(JSC-16075) AUTOMATIC DATA PROCESSING EQUIPMENT (ADPE) ACQUISITION PLAN FOR THE MEDICAL SCIENCES (NASA) 35 p HC A03/MF A01 N80-12746
CSCL 09B Unclas
63/60 41215

SPACE AND LIFE SCIENCES DIRECTORATE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

TABLE OF CONTENTS

I. Introduction.....	1
II. Requirements.....	4
III. Current System Configuration.....	18
IV. New System Configuration.....	20
V. Estimated Cost.....	25
VI. Method of Acquisition and Schedule.....	26
VII. Alternatives.....	29
VIII. Impact of Nonapproval.....	31

I. Introduction

The Space and Life Sciences Directorate (SLSD) Medical Sciences Division (MSD) requirements for real time and near real time data processing of operational, laboratory, institutional, and experimental data will increase dramatically during the Orbital Flight Test (OFT) and Mature Operations (OPS) phases of Shuttle. This increase is attributable to the following:

- o Increased frequency of Shuttle flights, up to 50 per year
- o Increased support for laboratory data analysis and processing
- o Overlap of training, simulations, and flights
- o Added programs for Shuttle requiring SLSD/MSD support
- o Added flight personnel involved for each Shuttle flight, simulation, etc.

The purpose of this acquisition is to provide the SLSD/MSD with an effective mechanism for meeting its' data handling/processing requirements for Shuttle. The ability to meet these requirements depends upon the availability of a general purpose high speed digital computer system. This system will be used to implement those data base management and processing functions required across all SLSD/MSD programs during training, laboratory operation analysis, simulations, mission operations, and post mission analysis/reporting.

The following (along with figure 1) delineates the major SLSD/MSD programs which require support from the proposed system:

0 Medical Operations Support

- Crew, Passengers, and Controller's Medical Examination
- Food Inventory Scheduling and Tracking
- Shuttle Inflight Medical Evaluations
- Microbial, Toxicological, Atmospheric, and Radiological Evaluations
- Emergency Medical Support Services
- Water, Waste Management, Personal Hygiene
- Health Stabilization and Environmental Assessment

0 Laboratory Support

- Neurophysiology Laboratory
- Body Fluids Laboratory
- Cardiovascular Laboratory
- Environmental Physiology Laboratory
- Bioprocessing Laboratory
- Cardiopulmonary Laboratory
- Toxicology Laboratory
- Bone and Muscle Laboratory

0 Institutional and Special Projects

- Dispensary
- Cellular Image Analysis
- Physiological Modeling

LABORATORY
SUBSYSTEM
SUPPORT
(35%)

- CLINICAL
- CARDIOVASCULAR
- CARDIOPULMONARY
- NEUROPHYSIOLOGY
- ENVIRONMENTAL PHYSIOLOGY
- BIOPROCESSING
- TOXICOLOGY

- MODELING
- IMAGE ANALYSIS

- DISPENSARY
- ARCHIVAL
- BUDGET
- TRAVEL

- CREW EXAMINATIONS
- MICROBIAL ANALYSIS
- RADIATION SAFETY
- FOOD INVENTORY
- HEALTH STABILIZATION
- BREATHING GAS MIXTURES AND PRESSURES
- WATER, WASTE MANAGEMENT, PERSONAL HYGIENE
- NUTRITION
- MEDICAL/DENTAL TRAINING
- EMERGENCY MEDICAL SUPPORT
- JSC MOCR CLINIC
- ENVIRONMENTAL EFFECTS
- SCHEDULING
- MSD DATA/REPORT TRACKING
- MSD REPORT GENERATION

FLIGHT
MEDICAL
OPERATIONS
SUPPORT.
(40%)

SPECIAL
PROJECTS
(10%)

INSTITUTIONAL SUPPORT (15%)

Figure 1 - Activities to be Supported
by Proposed Systems and Appropriate Percentages

II. Requirements

The projected life cycle of the proposed system is ten years. Therefore, the system must possess high flexibility, reliability, and speed to provide the data base and processing capabilities required across all SLSD/MSD programs. These system characteristics will ensure the ability (1) to perform multi-disciplined data base management and processing of real time and near real time data and (2) to adapt to program and/or requirements changes in a cost effective manner.

The following sections delineate the requirements for each of the SLSD/MSD programs to be supported by the proposed system:

- A. Medical Operations. The proposed computer system must provide for multiple simultaneous remote inputs/outputs from JSC, KSC, and DFRC in support of all Shuttle ground based medical operations. The following delineates those medical operations to be supported:
 - o Preflight and postflight medical examinations of all flight crew personnel.
 - o A data base of specialized medical and dental consultants in support of flight crew health care at JSC, KSC, and DFRC.
 - o A data base of JSC/MOCR Clinic provided services, staffing, scheduling, and medical supply inventory.

- o A data base for real time medical tracking of infectious disease exposures for both prime and backup crews, and families, in support of the Health Stabilization Program. Data input and retrieval must be available at JSC, KSC, and DFRC.
- o A data base of physical examination results for all JSC flight crew personnel in support of the Flight Medicine Clinic. In addition, the proposed system must provide a tracking mechanism to insure scheduling of periodic examinations.
- o The proposed system must provide a mechanism for tracking, scheduling, and maintaining medical, dental, and SLSD experiment related training for all flight crew personnel. Included shall be summaries on the use of various items i.e., medical kit, plus references to detailed usage instructions. Training and certification of EMS, crash/rescue, MCC/MOCR medical operations, laboratory, and support personnel at JSC, KSC, and DFRC must be scheduled and tracked via the proposed system.

- B. Inflight Medical Support. Multi-discipline inflight operations involving crew safety must be supported by the proposed system. This support must provide both real time and near real time data collection/retrieval and analysis at JSC, KSC, and/or DFRC, for each discipline.

The following delineates those operations which must be supported by the proposed system:

- o To insure proper crew noise protection, audiometry test for all crew members will be run. The proposed system must maintain a test result and history data base for all audiometry tests.
- o The proposed system must maintain a data base of preflight and flight daily diet nutrient content and water consumption for all crew members. This data must be analyzed against a set of standards for nutrient consumption with appropriate annotation of any deviations from the projected norm for each crew member.
- o The proposed system must maintain a data base of all food items, and their associated stowage location codes, for crew preflight, flight, and postflight meals. This data base must be updated in real time to reflect consumption and remaining food inventory. Additionally, a basic food inventory system for the JSC Food Handling Facility must be made available via the proposed system.

- o A data base of all candidate crew members radiation exposure history must be maintained via the proposed system. Compatibility of selected crew member exposure with projected mission radiation exposure must be determined by the proposed system (i.e., adherence to exposure limits set forth for bone marrow, skin, and eyes at 30 day, quarterly, yearly, and career exposure limits). In addition, a status and usage summary of all active and passive dosimeters assigned to individual crew members and/or to specific locations within the Shuttle vehicle must be maintained on the proposed system.
- o The proposed system must maintain an inventory and stowage list of waste management and personal hygiene items to assure completeness and advise Shuttle crew members on availability. This inventory must be updated in real time to reflect usage and current availability.
- o Scheduling and status of all microbial contamination sampling and analysis must be available on the proposed system. A data base containing results, and histories of all sampling accomplished for (1) each crew member, (2) each Shuttle vehicle, including the waste management system, food galley, and potable water area, and (3) the JSC food processing facility, including air, machines, preparation surfaces, and packaging materials must be maintained on the proposed system.

- o The proposed system must provide a record of all medical kit items, their functions, and stowage location for each flight designated medical kit. Consumables, such as medications, swabs, etc., must be tracked in real time to provide a current status of kit item availability during all phases of Shuttle flight.
- o Remote terminal access to the proposed system must be available at each Emergency Medical Support (EMS) site. This will provide access to all pertinent medical records/history for each crew member, that may be required during treatment at the EMS site. A data base must be established for entry of the following parameters relating to Shuttle crew member's EMS treatment.
 - Patients condition on delivery to EMS facility
 - List of treatment, including date and time administered
 - Patient response to treatment
 - Medical diagnosis
 - Names of EMS support personnel and on-site physician

C. Laboratory Support

Each of the SLSD/MSD support laboratories has implemented or is projecting implementation of microcomputer or minicomputer based data acquisition and control systems. The following delineates the SLSD/MSD laboratories and the applicable subsystem(s):

<u>Laboratory</u>	<u>Subsystem</u>
Clinical	Cellular Analysis Scanning System (CELSCAN)
Toxicology	Toxicology/Trace Gas Analyzer Processing System
Cardiopulmonary	Cardiopulmonary Data Acquisition System
Cardiovascular	Cardiovascular Data Acquisition System
Environmental Physiology	Metabolic Rate Measurement and Nitrogen Washout System
Environmental Physiology	Skin Temperature Measurement System
Bioprocessing	Bioprocessing Control and Acquisition System
Bioprocessing	Bioreactor Control System
Neurophysiology	Muscle Reflex and Sled System
Neurophysiology	Nerve Reflex and Chair Controller System
Bone & Muscle	Tomography System

The SLSD/MSD laboratory microcomputer systems delineated above were designed for data acquisition, local display, and experiment control only. As such, they do not possess the analysis, storage, retrieval, etc., capabilities required by the various SLSD/MSD laboratories.

The proposed computer system will provide for multiple simultaneous inputs of specific laboratory data from each of the above systems. This input capability will provide for the generation, input, update, etc., of laboratory specific data bases via the proposed systems' Data Base Management Software (DBMS). In addition to providing each laboratory with the required data base capabilities the proposed system will provide processing, analysis, output product generation, etc., of the laboratory acquired data. These functions will be available to each laboratory via remote interactive graphic terminal interfaced to the proposed SLSD/MSD computer system.

The remote terminal interface to the proposed computer system will also provide each laboratory with the capability of (1) processing data acquired during Shuttle operations support, (2) executing the various computer models resident on the proposed system, (3) development and execution of laboratory specific analysis software, etc.

D. Modeling/Analysis. The SLSD/MSD is currently leasing time on NASA and contractor computer systems for the execution of various computer models and image analysis software packages. The proposed computer system will provide the SLSD/MSD with the capability of implementing and executing each of the following models/analysis software packages. This capability will negate the requirement for leased computer time on various NASA and contractor computer systems.

o Erythropoiesis Model

The Erythropoiesis Model is utilized for clarification of basic concepts in erythropoietic regulation and, in particular, for investigating the loss of red cells in crew members in returning from spaceflight. The model predicts hematologic responses to stresses such as hypoxia, red cell infusions, hemoglobin abnormalities, bedrest, and spaceflight. The model is used in a predictive mode to estimate physiological quantities evaluate sensitivities of various parameters relative to erythropoietic control.

o Metabolic Balance Model

The Metabolic Balance Models are used for analyzing and reducing large quantities of spaceflight data in order to depict the metabolic, fluid, electrolyte, and hormonal responses to extended periods of weightlessness. All analysis and data base processing is based on daily fluid and mass inputs and outputs for each day of preflight, flight, and postflight periods. Data will be collected and analyzed for both the prime and backup crews of each Shuttle flight.

o Calcium Model

The Calcium Model is currently being implemented to analyze and evaluate bone mineral loss during spaceflight. The model evaluates the actions of three controlling hormones: (1) kidney, (2) gastrointestinal tract and (3) bone. Evaluation and analysis shall be based upon Shuttle flight data and data acquired during ground based bedrest studies.

o Physiological Parameter Analysis

The Physiological Parameter Analysis software consists of a set of interactive data analysis and data base processing programs. The data base software provides the capability to retrieve data across all experiments and models for processing via the interactive analysis software. Data retrieval and analysis by man, flight, mission phase, day of year, etc. is provided by this package.

o Statistical Design of Life Sciences Experiments

Statistical methods, utilizing existing data bases and simulation models, are used to test the design of the Life Sciences Spacelab experiments. The statistical design of the experiments is based on the kinds of treatment planned, the expected results, and the subject population of interest. The statistical analysis will estimate the magnitude and timing of expected responses, number of subjects, measurement accuracy, and necessary experiment controls.

o Whole-Body Algorithm

The Whole-Body Algorithm (WBA) is a collection of individual models used for simulating the response to various stresses with both long term and short term responses. The individual models simulate long term fluid and electrolyte regulation, short term cardiovascular response to exercise and LBNP, and respiratory and thermoregulation responses to stress.

o Image Analysis Software

The Image Analysis Software is a comprehensive set of programs used for the analysis and classification of digital imagery data. The software is used in the analysis of (1) red cell mass loss observed in spaceflight, (2) calcium loss during spaceflight, (3) effects of spaceflight on the cellular immune responses, etc.

- o Color Classification Analysis

The Color Classification Analysis software is a comprehensive set of programs used to measure the relative changes in the absorption spectra of digital images.
- E. Report Support. The proposed system must support the Medical Operations Management Board and associated control teams in preparation of all required Shuttle reports. This support must provide for (1) scheduling and statusing of all required reports, (2) acquisition and analysis of all Shuttle medical data required for each report and (3) archival summary of all archived Shuttle medical information/data required for various reports. The archival summary shall contain a list of all archived medical information, by type and subject for each respective Shuttle flight. Access to this list/data must be available via remote terminal to the proposed system.
- F. Data Tracking/Archival. The SLSD/MSD shall be responsible for tracking and controlling all medical data items generated during each Shuttle flight. To facilitate management and control of Shuttle flight specific medical data items, a data base must be established on the proposed system for tracking of medical data items for each Shuttle flight. Each element on the data base must contain:
 - o Summary description of data item
 - o Classification
 - o Location of data item

- o Point of contact for access
- o Date logged in
- o Archive status
- o Disposition actions
- o Log out/log in record

Access to the tracking data base, by element, must be available via remote terminal.

The Space Life Sciences Archival Library (SLSAL) shall be responsible for the archiving of all data and documentation generated by Space Life Sciences during each Shuttle flight. The proposed system must provide a capability of acquiring data tagging, for cross-referencing, and for locating specific information in the Archival Library. Further, the proposed system must provide summary reports of the archived data ordered by program, mission, data type and/or access number. Finally, tracking information relating to information/data status must be available to the SLSAL via remote terminal to the proposed system.

Schedule/Status Subsystem. A scheduling, status, and discrepancy reporting system for all Shuttle medical data operations must be maintained on the proposed system. This will provide NASA management and SLSD with immediate access to all medical system and subsystem status. Access shall be via remote terminal to the proposed system.

Schedules will delineate the function to be performed, when the function is to be performed, and the status of performance of the appropriate function to date. The proposed system will automatically initiate a discrepancy report (DR) upon detection of function non-performance. The DR must delineate the function, the responsible organization, the scheduled disposition of the DR, and the severity of the DR (i.e., other functions affected, possible slip of Shuttle flight, etc.). Upon completion of the rescheduled function, the DR will be closed and the status updated to reflect implementation completion.

- H. Requirements Summary. The SLSD/MSD programs delineated herein require a mechanism that will provide for a timely integration of Shuttle, life sciences, and medical data from multiple sources, systematically organize it, provide each user with their required analysis capabilities, and distribute resultant data to the SLSD users in a useful format.

Functionally, the proposed system must provide the following capabilities at JSC, KSC, and DFRC:

- o Generalized storage and retrieval capability.
- o A mechanism for communication control within the SLSD.
- o Real time interactive terminals with both alphanumeric and graphic capabilities.
- o Command and control mechanisms.

- o Communication link to KSC and DFRC.
- o Analysis and output product generation of all laboratory and Shuttle operations data.

III. Current System Configuration

The Space and Life Sciences Directorate's (SLSD), Medical Sciences Division (MSD), medical data operations are currently supported by the Medical Information Computer System (MEDICS) located in Building 37.

The MEDICS computer, a Varian Data Machine (VDM) V72, was procured by the SLSD in 1972 and is configured as follows:

- o V72 CPU
- o 96K WORDS MEMORY
- o 29 MBYTE SYSTEM DISK
- o 93 MBYTE DATA DISK
- o 2 9-TRK TAPE DRIVES
- o 2 7-TRK TAPE DRIVES
- o 2 16-CHANNEL MULTIPLEXERS
- o 132 COLUMN/400 LINE PER MINUTE PRINTER
- o HIGH SPEED PAPER TAPE READER
- o 80 COLUMN/300 CARD PER MINUTE CARD READER
- o OPERATOR CONSOLE CRT

Currently, MEDICS is supporting data base requirements for approximately 40 percent of the previously delineated disciplines. This support ranges from basic record management to complete data base storage and retrieval processing. Only limited capabilities are provided for data analysis and report generation. The remaining disciplines are new requirements for the Shuttle program and as such have not been implemented on the current MEDICS

system. Based on the SLSD/MSD Shuttle requirements, the current MEDICS system lacks sufficient capacity and peripherals to perform the required tasks. Further disadvantages in attempting to utilize the current MEDICS system for SLSD/MSD Shuttle support are:

- o The current system architecture is 10 years old.
- o The proposed system must support SLSD/MSD for Shuttle operations thru the 1980's.
- o New advancements in technology which are more cost effective cannot be utilized.
- o Due to the age of the system sparing will become increasingly difficult and costly.
- o Maintenance and downtime will increase as the system gets older.
- o Limited upgrade capabilities, which would support of the new requirements, are economically infeasible.

Therefore, in order for the SLSD/MSD to support their data operations during the Shuttle program, a new medical operations computer system is required. A new state of the art system will also provide the SLSD/MSD with the capability to incorporate any new requirements that may be levied on SLSD/MSD for future Shuttle programs in a cost effective manner.

IV. New System Configuration

The requirements for this application may be categorized as the integration, coordination, and analysis of data within the Space and Life Sciences Directorate Medical Sciences Division. Integration and coordination must be for both medical research projects and Shuttle program related functions. The computer system required for data management of SLSD/MSD Shuttle operations must be concerned with:

- o The interactive communications with multiple remote terminals at JSC, KSC, and DFRC.
- o The management, manipulation, and analysis of data stored on large random access devices.
- o The interactive communications with the Toxicology/TGA processing system at JSC.
- o The immediate response to the occurrence of several simultaneous events which dictate the allocation of the computer's resources.
- o The interactive communications with multiple microcomputer based laboratory subsystems at JSC.

The hardware configuration which supports SLSD Shuttle operations shall require, as a minimum, a central processor with the following capabilities:

- o Minimum 32 bit word length
- o Memory cycle time no greater than 700 ns
- o Memory expandable above 2 megabytes

- o Memory protection feature
- o Memory parity feature
- o Dual ported memory
- o Execution speeds for binary arithmetic of 1.5 microseconds maximum addition time, and 6.0 microseconds maximum multiplication/division time
- o Cache memory option at 300 ns cycle time
- o As a minimum, two arithmetic and two index registers
- o Multilevel indirect addressing
- o Multiply/divide hardware arithmetic
- o Floating point hardware arithmetic
- o Power failure/restart
- o Automatic bootstrap loader
- o Real time clock with time interval between interrupts not to exceed 100 microseconds
- o Interrupt control of a minimum of 32 multilevel hardware interrupts
- o Cycle-stealing I/O transfer rates as high as 500,000 8-bit bytes per second
- o Direct memory access with transfer rates no less than 5,000,000 8-bit bytes per second.

In addition, the CPU shall include the ability to accommodate the following peripheral devices which are required in the system minimum configuration:

- o Four 16-channel message oriented multiplexers or equivalent
- o One 7-track 800 bpi 75 ips magnetic tape drive
- o Two 9-track 800/1600 bpi 150 ips magnetic tape drives
- o Control/console with keyboard/printer
- o One 132-column line printer operating at no less than 400 lines per minute
- o One 80-column card reader operating at no less than 300 cards per minute
- o On-line moving head disk of at least 10 million bytes; transfer rate not less than 600,000 characters per second; average access time not to exceed 30 milliseconds for operating system, program storage and program development
- o On-line moving head disk of at least 100 million bytes expandable to 500 Mbytes, transfer rate not less than 600,000 characters per second, average access time not to exceed 30 milliseconds for life sciences data base.

The operating system software for the proposed computer system must meet the following requirements:

- o Support multiple terminal users simultaneously in a time sharing mode
- o Support software development in background to the operational user support
- o Support multiple-microcomputer network consisting of DEC LSI-11 microcomputers
- o Support FORTRAN IV, COBOL, BASIC, and assembly languages
- o Support rapid and easy program development via text editors, assemblers, compilers, debuggers, creation of executable modules, etc. Use of these support programs shall be available via remote terminal.
- o Support a large variety of hardware, including, but not limited to, disks, magnetic tapes, alphanumeric and/or graphic terminals, line printer and card reader.
- o Support a large, flexible, fast, and reliable data base management system which will permit, but not be limited to, the following:
 - oo Creation, deletion, extension, updating, printing, and manipulation of the data base
 - oo Assurance of data base, security, integrity, backup, and data recovery in case of error or system malfunction
 - oo Permit shared and/or exclusive data base access via user remote terminals

- o Support overlapped seeks for increased throughput on controllers with multiple disk drives.

V. Estimated Cost

The estimated cost for the proposed system is \$300,000 and includes hardware and software similar and equal to the following:

- 1 - DEC VAX 11/780 with 1.5 megabytes memory
- 2 - Magnetic Tape Unit and Controller (9-track)
- 1 - Disk and Controller (176 megabytes)
- 1 - Disk Unit (176 megabytes)
- 1 - Line Printer (600 lpm)
- 1 - Card Reader (300 cpm)
- 3 - 16-Line Multiplexers
- 1 - Operators Console
- 1 - VAX/VMS Operating System
- 1 - FORTRAN 4P Compiler
- 1 - COBOL Compiler
- 1 - TOTAL DBMS
- 1 - PLOT-10 Graphics Package

Funding for the system will be UPN 199-99 as noted in the FY 1980 budget.

VI. Method of Acquisition & Schedule

A. Method of Acquisition. The computer system will be purchased via sole source procurement from Digital Equipment Corporation (DEC) for the following reasons:

1. The Medical Sciences Division currently has a computer from DEC (a PDP 11/40) which is connected to multiple laboratories and provides analytical and storage capabilities whenever the laboratories needs exceed local laboratory computer capacity. The proposed plan incorporates these functions and the PDP 11/40 would be surplus. Many of the peripherals would work directly with the proposed system resulting in a net savings of at least \$50,000. A line printer, 9 track tape drives, and 16-line multiplexor fit this category. Additionally, each laboratory has LSI 11/04 microcomputer(s) with a floppy disk so they can continue data acquisition, testing, control, and local display if the central system goes down or is too busy to handle the workload. The floppy disk on the PDP 11/40 is used to load laboratory information into the system for those laboratories not connected by hard line. This floppy disk will be used on the proposed system thereby saving an additional \$4,000.
2. A wide variety of relevant and useable software has been written for the PDP 11/45 rented from Ford Aerospace and the PDP 11/40 supporting the laboratories. The image processing software represents at least 10 man-years of effort and needs

to be running as soon as possible after the new system is delivered to avoid continuing rental fees on the Ford Aerospace system. All programs for analyzing 0-g aircraft vestibular data would have to be rewritten to support this active program. Software support obtained from U.T.M.B. for the Neurophysiology Laboratory animal research would have to be completely rewritten should equipment other than DEC be selected. This represents at least five man-years of effort. Additionally, all of these programs could be run in the simulator mode to avoid rental cost while making any necessary modifications. No other system could provide this capability.

3. Since the proposed system is the same as the Life Sciences payload system, developmental software, familiarization, implementation, checkout, and program conversion can begin immediately, thereby relieving scheduling problems in meeting the Orbital Flight Tests series flight.
4. Compatibility with other Life Sciences elements at both the Johnson Space Center (JSC) and Ames Research Center (ARC) is critical for the proposed system. At JSC baseline data and inflight experiment data will be collected on the Life Sciences payload system which will then forward it to the proposed system for further processing. Further, laboratory data will need to be transferred to the payload system for experiment training and occasional comparison with inflight data to assure valid data is being collected. ARC will be involved with JSC on both cooperative bed rest studies

and ground and/or animal experiments. Exchange of this information within JSC and with ARC would be less costly and more timely if the proposed system is compatible. Compatibility with the Life Sciences payload system is also required in the case of a prolonged failure mode or if the batch workload is excessive. While the Medical Sciences Division and the Life Sciences Project Division have unique priorities, workloads can be shifted on a temporary basis should the need arise. If another system were selected, this requirement could not be met.

5. As noted, each of the laboratories are oriented around DEC microprocessors (and one PDP 11/34) and the flight micro-processor is DEC oriented. The proposed system will facilitate writing software for these systems and reduce program training costs since the systems are all within the same family. Additionally, hardlines to each of the laboratories will be simplified.
6. Because of the above considerations, any other vendor cannot meet the requirements, will inevitably increase costs, and will impact schedules.

B. Schedule. In order to meet the Orbital Flight Tests and mature Shuttle operations requirements, the following schedule is necessary:

1. Acquisition and installation of computer system hardware - February 1980.
2. Software Design Document - February 1980
3. Implementation of application software - June 1980
4. Begin modifications for mature operations - July 1980

VII. Alternatives

A number of alternative methods of supporting the SLSD Shuttle requirements delineated in this procurement have been examined.

One alternative would be to use an existing minicomputer system within the SLSD or JSC inventory. Examination of these alternatives shows they are either committed to existing functions or future Shuttle applications. Those systems available in government surplus (i.e., Varian 620 i's, 620f, etc.) are rejected due to (1) age (10 years or older), (2) out of manufacture, and (3) unavailability of the necessary memory, peripherals, or software operating system to meet the requirements.

Another alternative is to use one of the Life Sciences Shuttle experiments payload computers. This system was recently acquired to handle Life Sciences flight experiments development, training, baseline data collection, and inflight experiments monitoring for all flights involving Life Sciences. The proposed system must support all missions as well as all laboratories. Existing Life Sciences Shuttle experiments computers do not have sufficient capability and/or capacity to handle their functions plus all the functions of the Medical Sciences Division. Further, priorities associated with supporting all missions versus all Life Sciences missions would be extremely difficult if resources were excessively limited. Finally, the proposed system must be hardlined to some laboratories and utilized by programmers supporting the laboratory. The additional cost of these lines across the Center plus the daily operational problems of programming from a remote building would make utilization impractical from both a short and long term viewpoint.

Another possibility is to make use of the large JSC computer facilities in either Building 30 or Building 12. These large systems are either not configured to meet the SLSD requirements or they are dedicated solely to Shuttle flight/control operations.

In summary, the only alternative in meeting the multifunction needs of data storage, retrieval, analysis, and medical systems R & D is to acquire the proposed computer system.

VIII. Impact of Nonapproval

If the proposed system is not approved, it will be impossible for the Space and Life Sciences Directorate to provide the support required by the previously delineated programs.

For example, the data base, processing, and analysis support required by the various SLSD/MSD laboratory subsystems cannot be provided by the current MEDICS system. Without the proposed system, the various laboratories would be required to lease computer time, if available, on other JSC and/or contractor computer systems in order to meet their processing requirements. This option would both increase the cost of each laboratory program and make it difficult to manage and process common data across the various SLSD/MSD disciplines.

In addition, the processing requirements levied on the current MEDICS system for the Shuttle Program will increase dramatically. This is due to the increase in number of flights, shorter time between flights, and added flight personnel for Shuttle. Without the proposed system, a manual method must be used. This would both increase the cost of the program and increase the probability of mission failures for medical reasons. The cost of the proposed system must be weighed against the cost of additional personnel for the programs plus the jeopardizing of missions.

Similar considerations exist for many of the other programs delineated previously. The archival library, radiation safety, microbiology program, etc., all have increased processing and data requirements that must be met in order to insure proper SLSD/MSD support for the Shuttle program. Without the proposed system a majority of these SLSD/MSD programs would revert to a manual system thereby increasing personnel cost and probability of non-Shuttle support by SLSD/MSD.

In summary, the only, and most cost effective, means for the SLSD/MSD to support the Shuttle program is through the procurement of the proposed computer system.

**ORIGINAL PAGE IS
OF POOR QUALITY**