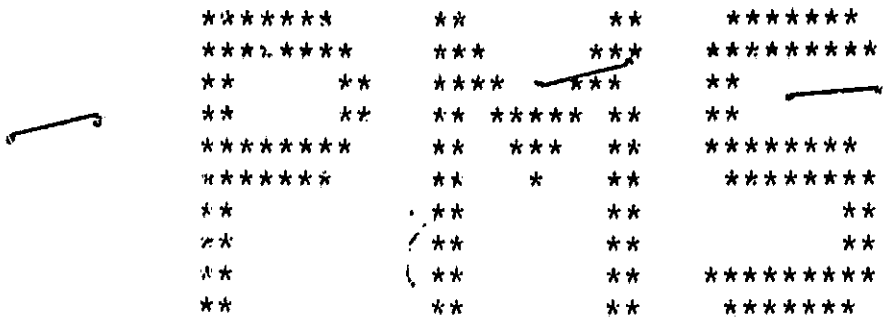

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PERFORMANCE MANAGEMENT SYSTEM

ENHANCEMENT AND MAINTENANCE

Final Report for the period January, 1984 - November, 1984

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16. Abstract

The research described in this report concludes a two-year effort to develop a Performace Management System (PMS) for the NCC computers. PMS provides semi-automated monthly reports to NASA and contractor management on the status and performance of the NCC computers in the TDRSS program. Throughout 1984, PMS was tested, debugged, extended, and enhanced. Regular PMS monthly reports Were produced and distributed. PMS continues to operate at the NCC under control of Bendix Corp. personnel.

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EXECUTIVE SUMMARY

This document contains a full description of the research conducted at the University of Louisville over the past year. The purpose of this research was to enhance and debug the current Performance Management System (PMS) for the UNIVAC 1100/82 at the NCC, and to extend PMS to operate on other computers at the NCC.

PMS provides a semi-automated system for generating monthly performace reports to NASA and contractor management. These reports summarize the activity of the operations partition of the UNIVAC 1100/82 at the NCC. This is the computer which supports TDRSS operations. The reports present tabular and graphical data showing such parameters as CPU utilization, memory utilization, and TIP thruput. These graphs and tables are accompanied by textual explanations.

Technical and administrative managers use the PMS reports to track the system's workload (for example, observing the change in workload during a shuttle launch), to anticipate system problems (for example, excessive utilizations which might threaten the system's reliability), and plan for system upgrades (for example, by observing which system resources are heavily or lightly used).

A PMS operator (currently from Bendix) must devote one to two days a month to perform the tape manipulation operations and report generation functions required by PMS. More time may be

required if system anomalies require research to explain the behavior in the PMS report, or if system malfunctions require special data recovery procedures.

During this research, PMS was debugged, and there are now no known instabilities in PMS. Furthermore, PMS was enhanced making it simpler, more reliable, and faster for the PMS operator. In particular, PMS now uses fewer tapes and is menu-driven. The current version of PMS is called PMS1R16. It is available in the NCC tape library on tape number 0754.

In order for PMS to be operated by personnel other than teh developers at the University of Louisville, it was necessary to fully document its features. Therefore, the following three manuals hve been generated under this contract:

Installation, Operation, and Maintenance Manual

Program Reference Manual

File Reference Manual

Copies of these manuals have been delivered to the Technical Officer for this contract and the PMS operator at Bendix. Other copies are archived at the University of Louisville.

PMS is currently in operation at the NCC, and it should continue to provide useful information to management for years to come.

PMS2 was developed under this contract to extend PMS to operation on the backup partition of the 1100/82 and the development computer at the NCC, a UNIVAC 1100/80A. This new

PMS version is more general than the one in current operation. It monitors more system parameters and provides a more "generic" report. By reconfiguring system data files (not programs) it can be made to operate on any of the three UNIVAC 1100 configurations at the NCC. PMS2 has been tested, and has been shown to produce usable reports, but it has not been approved for implementation on the NCC computers. The University of Louisville PMS researchers recommend that steps be taken to approve and activate PMS2 for implementation on all the NCC UNIVAC 1100 series computers. It should provide the superior performance reporting capability for all these computers that is now provided only for the operations partition of the UNIVAC 1100/82.

There were no inventions developed under this contract. There were no subcontracts which contained Patent Rights or New Technology clauses.

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NOMENCLATURE

ARM	-	Arcnive Module
DTV	-	Digital Television
ECL	-	Executive Control Language
FEP	-	Front End Processor
GSFC	-	Goddard Space Flight Center
GSTDN	-	Ground Spaceflight Tracking and Data Network
MOMP01	-	Manual Operation Module
NASA	-	National Aeronautics and Space Administration
NCC	-	Network Control Center
PDL	-	Program Design Language
PMS	-	Performance Management System
SIP	-	Software Instrumentation Package
STDN	-	Space Tracking and Data Network

1. INTRODUCTION

1.1 Statement of Problem

Under the extension of the National Aeronautics and Space Administration (NASA) Contract NAS5-26504 with the University of Louisville, the maintenance and further development of a semi-automated Performance Management System (PMS) was undertaken for the Network Control Center (NCC) of the Tracking and Data Relay Satellite System (TDRSS). PMS analyzes the major resources and system workloads of the NCC computer, a Univac 1100/82. The PMS system prepares and prints monthly reports documenting the performance of NCC's UNIVAC 1100/82.[1] It was desired by NASA that PMS's manual operations (the procedures required to produce the monthly reports) should be enhanced for smoother operation of PMS. The contract also required that PMS be extended so that it could evaluate all the NCC UNIVAC 1100 series computers at the NCC. This report describes in detail the enhancements and modifications performed on PMS to meet these requirements.

1.2 Background

Performance evaluation, the determination of how well a system is able to complete its specified tasks, is essential to the successful application of virtually every technology. System designers, installation directors, data processing and corporate members, system analysts, program

managers, and computer users at all levels have to cope with problems that could be solved substantially more easily and more satisfactorily with some knowledge of performance evaluation methodologies, techniques, and tools.[2]

All computer systems have to address problems that require considerable involvement in performance evaluation activities. For example, configuration design, system tuning, upgrading, scheduling, operation's management, and short and long term planning are important aspects involved in a computer system. As is the case with the NCC, the increasing complexity of modern computer systems, the increasing significance of tasks being delegated to computers and future upgrading to their system, have necessitated that computer system performance become an important consideration for their developers and those responsible for system operation.[3]

To analyze the performance of any computer system, the productivity, responsiveness, and utilization of the system must be quantified into a set of indices to be compared with performance standards. Methods used to determine these indices fall within three categories: direct measurement, simulation, and analytical techniques. Direct measurement uses monitors that sum events as they occur in the system and convert counter values to indices. Hardware or software monitors may be used. Hardware monitors use probes connected to the computer while software monitors are usually incorporated in the computer's operating system and

run concurrently with application programs. Simulation; the second method of evaluation, uses system specifications, information collected by monitors, or both to model the system's hardware and its workload. A simulation program which uses these modeled parameters imitates the system by reproducing a sequence of events which corresponds to actual events taking place in the system. A third method of performance evaluation using analytical techniques represents a system by a set of mathematical equations. These equations are developed using Markovian queuing network theory or operational analysis.[4]

All three performance methods have advantages over each other. Direct measurement is the most accurate, but requires an operational system. The system's hardware and software must be in the final stages of development. Simulation requires development of complex programs to simulate the target system. These programs take time to develop and debug, but they do not require the target system to be developed. Because the system's operation is imitated, simulation can produce results which are almost as accurate as direct measurement. Analytical techniques may produce results quickly, and such techniques are easily changed in response to system changes. They are usually not as accurate as simulation or direct measurement. Performance indices for a system and modification assessments that can be produced quickly are useful for efficient system management.[5]

All three performance evaluation methods were used to evaluate the NCC computers in previous research at the University of Louisville under contract NAS5-26504. Chief responsibility for development of measurement methods, simulation, and analytical system modeling was undertaken by J. G. Darnley, G. G. Crush, and A. M. Long tively. The measurement methods gathered all the data from the NCC's computers necessary to perform the simulation and modeling experiments. The monitor used to gather this in- formation is called Software Instrumentation Package (SIP). SIP accumulates and records most of the activities of the UNIVAC's operating system and hardware devices. Because data collected by SIP require very large files, data reduction programs were developed to reduce the SIP data into useable formats and also to produce performance summary reports from the UNIVAC 1100/22 then installed in the NCC. At this point, simulation and modeling programs analyzed the data-base created by SIP/PAR to evaluate the TDRSS network.[6] As a result of the application of the above methods, it was deter- mined that the UNIVAC 1100/22 used by NCC for TDRSS activity was inadequate, but an upgrade to an 1100/82 model would suffice.[7]

An outgrowth of the above research was a proposal to use the measurement methods to monitor the operations partition of the new UNIVAC 1100/82 and report on its performance. A system needed to be developed to obtain detailed analysis of the data-base that could be obtained

from SIP-collected data and PAR reduction of it. This system would be run periodically and would produce reports on the current status of the NCC's computers could be included in this new system. It was desired that the reports produced could be used by management, as well as technical specialists. The members of the team that designed the performance management system for the NCC were R. D. Shelton, T. G. Cleaver, A. M. Long, M. Shive, L. B. Drake, and A. B. Shah.[8]

The NCC's computers are a part of an extension to the existing Ground Spaceflight Tracking and Data Network (GSTDN) which is responsible for communications with low orbiting NASA spacecraft. To increase the satellite communications and coverage significantly, the TDRSS was designed because user satellites were frequently out of communication with any ground station. Another major advantage of TDRSS is that more modern technology is used than with STDN, so that a wider range of communication rates is provided. The Network Control Center controls and monitors are a part of the TDRSS system. The NCC has front end processors (FEP) which are UNIVAC Varian 77 600 minicomputers, and a custom digital TV (DTV) system which drives operator workstations. The NCC is built around a UNIVAC 1100/82 mainframe computer with dual processors that normally runs as a partitioned system, one processor for operation and the other for testing. There is also a UNIVAC 1100/80A mainframe computer used for software development.

The PMS system was developed for the NCC which is located at the Goddard Spaceflight center (GSFC).[9]

Throughout 1983, PMS was developed by the University of Louisville design team, and in October 1983, it was delivered to NASA/GSFC as an operational system. Below is a brief discussion of PMS as configured on that delivery date. More detail is available in the Final Report for 1983 (see bibliography).

The PMS system was broken down into seven modules. The first module which needed to be accessed when generating a performance report was the Manual Operations Module (MOM). This module prompted the PMS operator for information, such as the operator's name, report date, report period, and threshold values. Also, MOM set up the major units of PMS for execution.[10]

Data elements were stored intwo classed of files: Internal Data Base and the External Data Base. The Internal Data Base contained all data files required during a run of PMS. The External Data Base contained the PMS system files that were stored on magnetic tapes, including the trend files. These trend files contained daily averages for parameters such as the NCC workload, CPU utilization, memory utilization, and utilization of the busiest disk drive. The Archive Module (ARM) automatically interfaced PMS's Internal Data Base and External Base.

The Data Reduction Module (DRM) reduced SIP performance data collected during the month. Raw

performance data was collected continuously by SIP and was written to data files as blocks of raw performance data every thirty minutes. A PAR program reduced the data collected from SIP, then created the Consolidated Data Base (CDB) files. The CDB files contained performance data for an entire report period. These data were chronological, and if data were missing for any time period, flags were provided.[11]

The Report Generation module produced the monthly performance report. (See the Installation, Operation, and Maintenance Manual, Appendix I for an example of a typical report.) Two tables were contained in this report: Busiest Day Summary and Daily Average Report. The Daily Average Report gave a summary of daily performance averages during an entire month. The Busiest Day Summary table reported on the busiest day during the report period. This day could be specified by the PMS operator.

There were scatter plots in the monthly report for CPU, memory, and disk utilization. These scatter plots showed how the major resources relate to each other. Trend graphs were contained that reported on the NCC's CPU, memory, and highest disk utilization during the report period. Conditional reports were automatically plotted if threshold values were exceeded. These values were manually set by the PMS operator in the Manual Operations Module. It was possible to plot up to 25 conditional reports.

A Performance Monitor Module (PMM) along with MOMP01

allowed the PMS operator to start and stop the PMS software at various stages when generating the monthly report. This was helpful when testing and debugging the PMS system. When data integrity errors occured when executing PMS, the PMM would stop execution and provide error statements for unrecoverable errors.[12]

The Maintenance Module (MAM) made it easier for the PMS operator to maintain the PMS system. This included maintenance of command files which compile and link programs. The PMS monthly performance report and the system programs could be printed on the UNIVAC's line printer by executing the appropriate command files. Also contained were PAR programs that enabled the operator to determine if a SIP cycle file could be reduced by PMS.

PMS was not a general system and would only evaluate NCC's UNIVAC 1100/82 operations partition. PMS could not reduce data from the backup partition of the UNIVAC 1100/82 or a UNIVAC 1100/80A computer. As of December, 1983, PMS would reduce Software Instrumentation Package (SIP) cycles properly and produce a satisfactory monthly performance report as described. PMS required at least four magnetic tapes: a system tape, two trend tapes (one used for the purpose of positioning the other one) and a SIP tape or tapes. Data copied on the SIP tape was collected using the Software Instrument Package, located on the UNIVAC 1100/82. The data collected required reduction of large amounts of performance data which would eventually be used in the PMS

monthly performance report. The trend tapes contained reduced performance data from the previous three months. The system tape stored all programs and maintenance routines contained in the PMS system. PMS required a minimum of human input to generate a monthly report. PMS was designed modularly to help with debugging and future modifications to the system.

The modular design of PMS helped limit the size and functions of all its software routines. The modules and units were designed with minimum interface between each unit. This allowed for changes to be made to the system by changing small programs instead of large ones. Ease of future develpments to PMS was increased because of the flexibility designed into the system.

1.3 Preview of Report

The following text will describe the major modifications made to the PMS system. in the first section, the design methodologies used by developers of PMS are discussed. Then bugs found in PMS and enhancements made to PMS are discussed. Finally, the development of the new general version of PMS, which runs on all NCC 1100 series computers, is discussed.

2. MAINTENANCE OF PMS

2.1 Preliminary Activities

In accordance with the statement of work for this contract, the project team produced monthly PMS reports for the first six months of the contract. This activity had the following beneficial effects:

1. New team members gained experience in learning and using PMS.
2. High-quality monthly performance reports were prepared and distributed.
3. It provided a training period for the Bendix Corp. personnel who were to take over the operation of PMS.
4. System instabilities were detected and eliminated.

As a consequence of producing these monthly PMS reports, an important and interesting anomaly was noted in the behavior of the UNIVAC 1100/82. The CPU percent utilization would vary between two levels, 10% and 70%. This "bimodal" behavior was interesting in that it obviously represented some sort of "thrashing" or "deadly embrace" phenomenon, and it was important in that excessively high CPU utilization threatens the reliability of the computer system.

Subsequent studies indicated that the problem may

have been caused by competition for resources between SIP and OSAM. In accordance with this presumption, OSAM use was cut back severly, and the PMS reports reflected a reduction in the bimodal activity. Still, the University of Louisville staff regard the source of the problem to be unproved, and we continue to recommend that definitive tests be performed.

2.2 Debugging the PMS System

PMS is a large and complex software performance system. When dealing with programs on this scale, bugs in a system are inevitable. PMS was written modularly with the application of "top down" design techniques. This eased the difficulty in finding errors in the system.

The first major bug that was corrected was found when generating the 1983 December report. PMS had difficulty in creating files needed to produce the December monthly report. Apparently, PMS did not handle new year transitions properly. The error was found in Data Reduction Module DRMPR4. A logical condition was tested improperly. When the first month of the year was calculated, it was defined as thirteen. Consequently, all subsequent months calculated were offset by one (the second month of the new year is calculated as the first month). The system was corrected and tested again, but the monthly report still could not be produced. Later, it was discovered that a

trend file had a date that was out of sequence. The bad datum was corrected and PMS was executed, this time producing a correct monthly report.

Program module ARMEI3 did not close a file called "MISCELLAN" properly, generating an error when other modules read the file. MISCELLAN contains five records. After ARMEI3 finished writing the fourth record into MICELLAN file, the file was closed; thereby, altering the number of records in the file from five to four. Any program that tried to read a fifth record in the MISCELLAN file would generate an error. To correct this error, ARMEI3 was changed to write a dummy fifth record in the MISCELLAN file.

A scheme was prepared for avoiding an annoying message. When PMS had difficulty handling a SIP cycle, a program module occasionally generated a message "***DRMFB1#3 -- NONFATAL ERROR IN READING SPHISTORY" to the terminal. PMS may even be in an infinite loop when this message appears on the screen. After this message is displayed several times on the monitor, the PMS system operator wonders if a SIP cycle cannot be reduced. If the SIP cycle cannot be reduced, it should be marked for skipping and PMS should be run again. To help the operator make this decision, the PMS software was corrected so that the error message is written to the monitor once, then it is written to a file called "TRACER" along with a counter, so that the number of times the error message occurs is readily apparent. If the PMS system is in an infinite loop trying

to reduce a SIP cycle, the DRMFB1 error message can only be written into the TRACER file several thousand times. Once there is an overflow in the TRACER file, the PMS system will crash. The PMS operator will then know that a particular SIP cycle cannot be reduced, and will mark this cycle for skipping before running the system again.

Once modifications were made to the PMS system, they were documented. Change Request forms were filled out to reflect changes made to the system. The program's PDL was also changed to show the new logical flow of its modified program. Overall, the PMS system did not have any major errors. Changes made to PMS were subtle modifications, but necessary if PMS was to operate reliably.

2.3 Enhancing the PMS System

Previously, PMS was not especially user friendly. This made it difficult for beginning PMS operators to run the system properly. An indepth knowledge of PMS and UNIVAC ECL was required to produce satisfactory PMS reports consistently. This is especially apparent when trying to run the Report Generation module to produce the tables and graphs contained in the reports.

In order to increase PMS ease of operation, it was decided that PMS should be accessed through a menu driven program. The menu program executes all pertinent procedures of PMS to ensure PMS proper operation. By having a menu driven program of the major operations of PMS, the operator will be more aware of the types of operations that PMS can

perform since these operations are listed in the menu program. An indepth knowledge of how PMS functions operate is still required of the PMS operator when problems develop, but the menu program makes it easier for the operator to be competent in routine operation of PMS. He is more aware of the different functions PMS is allowed to perform.

The menu program is a FORTRAN program (See the Program Reference Manual for a complete listing) that is automatically executed by the procedure that loads the PMS system from magnetic tape to disk files. Through the menu program, PMS may be set up for operation and executed. The menu program has 15 options. Option A deletes all the files needed by MOMP01. Normally, the files used in the execution of MOMP01 are handled properly, but if there is a problem when executing MOMP01, this option is selected. It will allow the user to start from scratch and enter a new set of parameters in MOMP01. Option B allows a user to set up the PMS system for a monthly performance report run. This involves entering the operator name, beginning and ending dates of the monthly report, SIP cycles to be used by PMS, threshold values for devices configured on NCC's UNIVAC 1100/82, and modules of PMS selected for execution. Option C executes the PMS system. The modules of PMS that will be run are determined in module MOMP01. When changes need to be made to any program in PMS, Option D will compile the edited program. Once modified programs are compiled, Option E may be selected to map (link) the entire PMS system. If

it is desired to save PMS on any tape number, especially after modifications are made to PMS, Option F may be selected. To obtain a complete listing of all programs and ECL command files contained in the PMS system, Option G is selected. To print the monthly performance report generated by PMS, Option H is selected. The monthly performance report is sent to the UNIVAC's main line printer. Option I gives instructions on how to execute the PARQA. PARQA determines whether a particular SIP cycle may be used by PMS. Whenever an operator desires a listing of files currently on a magnetic tape, Option J may be used. The operator only needs to input the number of the tape he wants to look at. As PMS is used, the two work files (PMS and UTILITIES) accumulate an excessive number of versions of a file element. In order to minimize the disk space useage of PMS, Option K is selected to delete all file elements, except the most recent version. Option L concentrates two files, 66 columns each, into a file of 132 columns. The interlaced files are used as documentation in the PMS monthly performance report. Option M performs a catalog that lists disk files created under a user's account number. A catalog is performed periodically so that the PMS operator can delete unwanted files to conserve disk space. Option N lists the current disk file usage of a user while logged on a UNIVAC 1100 series computer. This option is helpful to the operator in case PMS does not execute successfully. The operator can determine if all files needed by PMS were

assigned. Option 0 exits the menu program and returns the user to the UNIVAC's operating system.

At the NCC, there was a limit for how much disk space each user is allocated. Because of the size of the PMS system, the disk space allocated for PMS was nearly full. PMS was analyzed to determine where in the system disk usage could be minimized. Previously, PMS copied SYSBALLOG files from tape to disk even if they are designated to be skipped by module MOMP01. A scheme was prepared in the ARM units to prevent loading in the SIP files to disk that will be unused in a monthly report run. This greatly reduced the disk usage of PMS.

Originally, the PMS system operated using three tapes: two trend tapes (which stored trend files) and a system tape (which stored the system files such as PMS and UTILITIES). When the system tape and trend tapes were changed periodically to save a new version of PMS files and trend files, this created difficulty for the PMS operator. It was easy for the operator to specify incorrect tape numbers that were to replace the former ones. This arises from the fact that modules which reference the system and trend files had the tape numbers hardcoded into their modules. If new trend tapes were to be used, the operator had to change the tape numbers in the programs. A new system tape required changing a tape number in an ECL command file that stores the PMS system from disk files to magnetic tape.

A further problem was that the use of three tapes was inconvenient and error-prone. The mounting and dismounting of three tapes by the UNIVAC operator took a long time, and the tape drives used were not always reliable. Changes were undertaken so that the files contained on the system and trend tapes would be stored on a single tape.

Changes were also made so that the user is now prompted for the system tape number the PMS system is to be stored on. Once all modules of PMS are executed, the system is saved on the specified tape number. The entire system is then deleted. This procedure forces the PMS operator to reload the PMS system every time he wants to generate a monthly report and reduces the chance that files needed by the system are rolled out. Once the PMS system is loaded from tape to disk the menu program is executed so that the the operator can immediately select which functions of PMS he wants to perform.

The enhancements discussed make PMS more reliable and faster running. Also, the system is contained on one tape (including the trend files) and is more automatic since the operator no longer concerns himself with the correct trend tape numbers needed by the ARM units.

2.4 Documentation of PMS

Once all enhancement developments were performed on PMS, three documens were produced:

PMS Installation, Operation, and Maintenance Manual

PMS Program Reference Manual

PMS File Reference Manual

Copies of these three documents have been provided to NASA and Bendix. Other copies are on file at the University of Louisville.

The Installation, Operation, and Maintenance Manual describes PMS operator procedures. Guidelines for installing, running and maintaining PMS are included. The operator is shown how to access SIP cycles on the UNIVAC 1100/82, then store them to magnetic tape(s). Once the SIP tape(s) are created, procedures describe how to determine the valid SIP cycles to be used in a PMS monthly performance report run. There is also an error recovery section that explains operator recovery options in case difficulty should arise while running the PMS system. Next, there is a brief description of the internal function of PMS. There is also an explanation of the chronological execution of the PMS system, while PMS generates a monthly performance report. The last section describes maintenance of PMS. Instructions are given that show how to compile programs, map (link) programs, minimize PMS disk usage, and save the PMS system on magnetic tape.

The Program Reference Manual gives listings of the PDL and code for all PMS programs, including supporting utility programs. This will serve as the primary reference for system modifications and enhancements.

The File Reference Manual provides descriptions of

all data files used by PMS. It includes file formats, variable names, and sample listings.

3. BENCHMARK TESTING WITH SHORT SIP INTERVALS

Bendix and CSC recognized that PMS reports provide performance data in a convenient and readable form, and that PMS reports could be produced much faster (one day) than other performance reports. They were therefore interested in using PMS to aid in analyzing benchmark tests and V and V tests on the 1100/82. Both Bendix and CSC requested that the University of Louisville personnel determine if PMS could be applied to such tasks.

PMS is configured to process SIP data taken at 30-minute SIP intervals over a period of several days. Benchmark and V and V tests use one-minute SIP intervals over a few hours. It was questionable whether PMS could easily be adapted to these short SIP intervals.

A test run of PMS with one-minute intervals was attempted. PMS processed the one-minute SIP intervals without difficulty. Normal PMS procedures were used to produce a PMS monthly report. Only three to four hours of data could be processed because the file generated by SIP would become too large for PMS to handle. The report produced using the one-minute SIP interval cycle contained all the tables and graphs normally generated by PMS. The trend graphs and Daily Average Report table produced trivial results because these graphs and tables are designed to summarize data for up to one month. Since only three to four hours of SIP data were used, the cycle was much too small to obtain meaningful results. In the Busiest Day Summary

table and other standard report graphs, useable data was recorded for memory, CPU, and highest disk utilization. Also, the conditional graphs that plot threshold parameters vs. time of day were successful. The resolution of the graphs was coarse because PMS summed the one-minute SIP interval raw performance data into 30-minute time slots.

It was determined that, with suitable modifications, PMS could be reconfigured to provide useful reports on benchmark tests. This remains an area of possible future research.

4. TRAINING OF A PMS OPERATOR

At the onset of the this year's research, NASA specified Bendix as the contractor who would eventually take control of the operation of PMS and the distribution of monthly PMS reports. In accordance with the contract, University of Louisville personnel undertook The training of the Bendix operator, E. Z. Block.

Throughout the first half of 1984, the Bendix operator observed and assisted in the generation of monthly PMS reports. He became familiar with PMS operation, the gathering of SIP data, and the tape handling routines.

In June of 1984, the operation of PMS was turned over to Bendix. In July of 1984, Bendix released its first PMS report, the report for the month of June.

As changes and upgrades to PMS were developed, the new releases were issued to Bendix. PMS reports continue to be generated by their PMS operator.

5. PMS2: DESIGN OF A GENERAL PMS SYSTEM

The PMS system described in the previous section was designed specifically to analyze data from the operations partition of the UNIVAC 1100/82. The contract required that PMS be extended so that it would operate on the backup partition of the 1100/82 and also on the 1100/80A, a software development machine.

5.1 Design Criteria

After extensive interviews with NASA and contractor personnel to determine the form and content of the new PMS, it was decided that PMS should, as nearly as possible, be the same for all three configurations. Differences among the three machine configurations would be handled by selecting different options and data files, but the PMS programs would remain the same for all three. This new PMS was dubbed "PMS2".

In order for PMS to run as a general performance system that could evaluate the NCC UNIVAC 1100 series computers, some of PMS's parameter specifications needed to be changed to match the environment of all three. All of the new parameters needed to be common for all the NCC UNIVAC installations. The parameters that were determined to be most useful were CPU utilization, memory utilization, average disk utilization, TIP throughout, TIP response time, demand terminals in use, demand response time, and batch jobs open. The PMS report given in Appendix C, however,

includes FEP and DTV information since these parameters are valuable for the NCC's 1100/82, for which the mentioned report was produced. The parameters which are general enough to be included in the new PMS tabular output were listed earlier and the three new parameters, demand terminals in use, demand response time, and batch jobs open, can easily overwrite the DTV and FEP data tabulated in the Report Generation module of PMS in a step towards the universilization of PMS.

5.2 Implementation

PMS1, the version of PMS which runs exclusively on the UNIVAC 1100/82, was used as the foundation for PMS2. The first task was to redesign the PAR reduction unit, DRMPR4, to acquire the additional parameters required of PMS2.

Although acquisition of TIP response time and demand response time were challenging problems, they were eventually acquired and DRMPR4 successfully passed its integration test. A listing of DRMPR4 is given in Appendix A.

DRMFRU, the Fortran Reduction Unit, had to be completely rewritten for PMS2. This complex and lengthy program creates the SPHISTORY file which is a structured SIP Data History. Fields of SPHISTORY represent the different parameters collected by PMS. The created SPHISTORY file is used by the FORTRAN Data Base Unit (DRMFB1, DRMFB2), to create the Consolidated Data Base files used by the rest of

PMS. The program is extensively commented and has detailed PDL. The listing of the program is given in Appendix B.

In order to make the new desired parameters available to PMS by the PAR reduction routines, a number of files had to be entirely reformatted. These files, namely PARAMADEF, PARAFLNMS, and THRESHOLD were each modified to include, respectively, a definition of the new parameter (needed to identify it from other parameters in PARDATAFL), the name given to the file which will be used to accumulate data at various times for the parameter, and a threshold setting, which, when exceeded, will trigger the generation of a conditional report for the parameter.

An entirely new file, called SYSCONFIG, was created. This file was developed in an effort to probe some crucial characteristics of the system which could then be displayed on the cover page of the PMS report. The existence of such a file became particularly desirable due to the need to identify a system report for the 1100/80A. The four records of this file are:

TOTEM: The main memory size of the system.

NUMCPU: Number of CPUs configured for a day.

EXLEVL: Executive level for a day.

DSKCNT: Number of disks up.

Upon completion, PMS2 was tested with a subset of the data for the month of August, 1984. The resulting PMS report is given in Appenix C.

The sample report produced by PMS2 proves that it can be successfully applied to performance management for NCC computers. Consideration should be given to applying PMS2 opertionally on all the NCC UNIVAC computers.

5.3 Toward a Universal PMS System

In May of 1984, University of Louisville personnel presented the current research at a meeting of the UNIVAC users' group, USE.[13] PMS2 was described, and its extension to PMS3 was also described. PMS3 was to be a version of PMS which would be able to run on any UNIVAC 1100 series computer, not just those at the NCC.

We received twenty-six requests from systems managers of UNIVAC installations to be beta test sites for PMS3. It is clear from this that there is great demand for a software tool of this kind.

As the present contract is expiring, we have no immediate plans to develop or release PMS3, but this remains a possible avenue of future research.

6. CONCLUSIONS

PMS has been an operational system since November of 1983. Although PMS could produce monthly performance reports at that time, a beginning PMS operator without much experience using the system would have some difficulty generating a PMS report. The enhancements made to PMS simplify the user's interface. An operator can now generate PMS reports without detailed knowledge of the internal operations of PMS. Documentation on PMS is now supplied to help the operator in case difficulties arise when executing PMS. The operator now has standard procedures to follow when installing, maintaining, and operating PMS. PMS is a more automatic system because the entire system is now contained on a single tape. By having the operator prompted for the tape number of the system's tape, errors are reduced when running PMS. All known bugs in PMS have been eliminated, thereby significantly increasing the reliability of PMS.

PMS is a viable and valuable tool for performance analysis of the UNIVAC 1100/82. It should continue to provide PMS monthly reports to NASA and contractor management into the foreseeable future.

PMS2, the general PMS system, is ready to provide performance analysis for all UNIVAC 1100 series computers at the NCC.

APPENDIX A

PROGRAM LISTING

PMS2*PMS.DRMPR4

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```
PROGPM*FILE(1).ORMPR4
@ UNIT INVOCATION NAME:  ORMPR4 (RAW SIP TO PAR HISTORY FILE)
@                        (PAR LANGUAGE PROGRAM)
@
@ PURPOSE:  TO CONVERT SIP PRODUCED PERFORMANCE DATA INTO FIXED FORMAT
@           HISTORY FILE
@
@ INVOCATION METHOD:  @RAM,PAR,CP SIPFIL.,PMS*PMS.ORMPR4,TPFS.
@                         ORMPR4 "NAMES"
@
@ EXTERNAL UNITS/SUBDIVISIONS OF THIS MODULE:
@ NAME     FUNCTION                       CALLED BY      CALLS       LANGUAGE
@ GETNIV   POSITION TO NEXT TIME          RSTFHIST         -            PAR
@          INTERVAL OF SIP DATA
@ SCALE    SCALES DOUBLE WORD INTO        BASEIV,ANALIV    -            PAR
@          A SINGLE WORD
@ INITIV   ALLOCATES ARRAYS AND           RSTFHIST         -            PAR
@          INITIALIZES DATA ITEMS
@ BASEIV   BASES DATA FROM A TIME         RSTFHIST       SCALE          PAR
@          INTERVAL BLOCK FOR
@          DIFFERENCING
@ ANALIV   ANALYZES (SUBTRACTS) THE       RSTFHIST     SCALE,WRITIV PAR
@          BASE DATA FROM NEXT BLOCK
@ WRITIV   OUTPUTS A TIME INTERVAL TO     ANALIV           -            PAR
@          THE HISTORY FILE
@
@ INTERMEDIATE VARIABLES:
@ NAME       DESCRIPTION
@ FELT       HISTORY ELEMENT IN OUTPUT FILE
@ INTLEN     LENGTH OF COLLECTION PERIOD IN MINUTES
@
@ FILE/ELEMENT REFERENCES:
@ FILE/ELEMENT NAME               USE               CONTENTS
@ SIPFIL.                          I        RAW SIP PERFORMANCE DATA
@ TPFS.NAMES                       O        ELEMENT OF REDUCED SIP DATA
@                                           FROM FILE SIPFIL.
@
@ DEVELOPMENT HISTORY:
@ AUTHORS
@ R.E. STURGEON/J.G. CARNLEY   REQT:  APPENDIX 3    INITIAL DRAFT 2/17/83
@                              HIPO:  DKM           SECOND DRAFT 3/31/83
@                                                   THIRD DRAFT 5/5/83
@                                CHANGED VIA CHANGE REQUEST E4-1 3/13/84
@                                CHANGED 7/06/84 FOR GENERAL PMS SYSTEM
@ UNIT FLOW
@-------------------------------------------------------------------------
@ OPEN OUTPUT HISTORY ELEMENT TPFS.NAMES
@ ALLOCATE INTERNAL ARRAYS FOR STORING INTERMEDIATE RESULTS
@ INITIALIZE VARIABLES TO ZERO (SEE MODULE INITIV)
@ GET AN INPUT DATA BLOCK FROM SIPFIL.
@ DO UNTIL SUMMARY BLOCK OR READ ERROR OR EOF
@      BASE THIS BLOCK (SEE MODULE BASEIV)
@      GET NEXT BLOCK (SEE MODULE GETNIV)
@      IF NEXT BLOCK VALID (NOT SUMMARY OR ERROR OR EOF)
@      THEN
@           ANALYZE NEXT BLOCK AGAINST BASE DATE (SEE MODULE ANALIV)
@           OUTPUT RESULTS OF ANALYSIS TO TPFS.NAMES (SEE MODULE WRITIV)
```

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```
        !       END IF
        ! END DO
        ! CLOSE OUTPUT TAPE,SAVE
        ! END
        !-----------------------------------------------------------------------
      FUNCTSIZE;=0.5                          ! SET FUNCTION SIZE UP TO 80
      LINSIZ:=132                             ! OUTPUT RECORD SIZE IS 132 CHAR
      INTLEN:=30                              ! SIZE OF OUTPUT INTERVAL IN MINS
      FUNCT DOPEN4 PELT                       ! MAIN FUNCTION FOR HISTORY COLLECT
          INTRTC:=INTLEN*60.0                 ! SIZE OF INTERVAL IN RTC UNITS
          I:=TIMSTP[]///4?2^20.0              ! COMPUTE SIP INTERVALS
          READ
          INTRND:=((TIMSTP[]///422.0^0)-1)/2  ! INTERVAL ROUND UP FACTOR
          REWIND
          READ                                ! POSITION TO START OF FILE
          CTIME:=TIMSTP[]///422^20            ! START TIME REL TODAY
          INTVNO:=(CTIME+INTRND)//INTRTC      ! CURRENT INTERVAL NUMBER
          ITINTV:=INTVNO                      ! SAVE THE INITIAL INTERVAL
          SYR:=SETDAY[,,S?]+64                ! SIP COLLECTION YEAR
          SMO:=SETDAY[,,S1]                   ! SIP COLLECTION MONTH
          SDAY:=SETDAY[,,S2]                  ! SIP COLLECTION DAY
          SDATE:=100*((100*SYR)+SMO)+SDAY     ! SIP COLLECTION YYMMDD
          INITIV
          POPEN PELT                          ! OPEN OUTPUT FILE
          IMEM:=MEMSIZE+64                    ! SYSTEM MEMORY SIZE IN WORDS
          INTVNO:=INTVNO-1                    ! SET TO START INTERVAL NUMBER
          WHILE ETYPE<>63                     ! LOOP UNTIL A SUMMARY BLOCK IS READ
              BASEIV                          ! BASE THIS INTERVAL
              GETNIV                          ! READ NEXT INTERVAL
              IF INTVIM>0                     ! WAS SIP ON DURING LAST INTERVAL
                  ANALIV                      ! YES THEN ANALIZE THE INTERVAL
              ENDIF
          ENDWH
          PCLOSE
      END
      FUNCT GETNIV                            ! READ NEXT INTERVAL DATA
          NT:=(INTVNO+2)*INTRTC               ! CALCULATE TIME OF NEXT INTERVAL
          WHILE 1                             ! READ UNTIL NEXT INTERVAL FOUND
              READ
              IF ISTAT<>0                     ! ANY READ ERROR?
                  I:=BLOCK                    ! SAVE LAST GOOD BLOCK NUMBER
                  REWIND
                  READ I                      ! READ TO LAST GOOD BLOCK
                  ETYPE:=63                   ! FORCE SUMMARY BLOCK TYPE
              ENDIF
              NCTIME:=TIMSTP[]///4220^20      ! THE TIME STAMP FOR THIS BLOCK
              IF NCTIME < CTIME               ! PASS MIDNIGHT
                  NT:=NT///4320^20
              ENDIF
              IF ETYPE=67
                  I:=NT+INTRND
              ELSE
                  I:=NCTIME+INTRND
              ENDIF
              LEAVE ETYPE=0                   ! LEAVE IF EITHER AT END OR PASS TIME
              LEAVE I>NT
          ENDWH
```

```
114         INTVTM:=ACTIME-CTIME
115         CTIME:=ACTIME                          & SET NEW CURRENT TIME
116         INTVNO:=I/INTRTC -1                    & CALCULATE NEXT INTERVAL
117         IF INTVTM<0                            & PAST MIDNIGHT ?
118         INTVTM:=INTVTM+24.0*3600.0
119              SDAY:=SDAY+1                      & YES ADVANCE DAY
120              IF SDAY > DAYMO(SMO)              & PAST END OF THE MONTH?
121                   SDAY:=SDAY-DAYMO(SMO)        & YES
122                   SMO:=SMO+1                   & ADVANCE MONTH
123                   IF SMO > 12                  & PAST DEC
124                        SMO:=SMO-12
125                        SYR:=SYR+1              & ADVANCE YEAR
126                   ENDIF
127              ENDIF
128         ENDIF
129         SDATE:=10000*((100*SYR)+SMO)+SDAY      & SIF COLLECTION YYMMDD
130    END
131    FUNCT SCALE X,Y                             & SCALE A DOUBLE WORD INTO SW
132         UW:=X
133         LW:=Y
134         LWS:=LW/01000000                       & SCALE DOWN BY 512
135         RND:=(Y+#0777)/#400                    & ROUND UP
136         IF LWS<0
137              LWS:=LWS+#777777777               &THE HICKLIN FIX
138         ENDIF
139         UWS:=UW*#1000000+LWS
140         SW:=UWS+LWS+RND                        &STORE COMBINED RESULT
141    END
142    FUNCT INITIV                                & ALLOCATE ALL ARRAYS NEEDED
143         ALLOCATE BP01,NCAU,BP02,NCAU,BP03,NCAU,BP04,NCAU,BP05,NCAU,;
144                  BP06,NCAU,BP07,NCAU,BP08,NCAU,BP09,NCAU,BP10,NCAU,;
145                  BP11,NCAU,BP12,NCAU,BP13,NCAU,BP14,NCAU,BP15,NCAU,;
146                  BP16,NCAU,BP17,NCAU,BP18,NCAU,BP19,NCAU,BP20,NCAU,;
147                  BP21,NCAU,BP22,NCAU,BP23,NCAU,BP24,NCAU,BP25,NCAU,;
148                  BP26,NCAU,BP27,NCAU,BP28,NCAU,BP29,NCAU,BP30,NCAU,;
149                  BP31,NCAU,BP32,NCAU,BP33,NCAU,BP34,NCAU
150         ALLOCATE PC01,NCAU,PC02,NCAU,PC03,NCAU,PC04,NCAU,PC05,NCAU,;
151                  PC06,NCAU,PC07,NCAU,PC08,NCAU,PC09,NCAU,PC10,NCAU,;
152                  PC11,NCAU,PC12,NCAU,PC13,NCAU,PC14,NCAU,PC15,NCAU,;
153                  PC16,NCAU,PC17,NCAU,PC18,NCAU,PC19,NCAU,PC20,NCAU,;
154                  PC21,NCAU,PC22,NCAU,PC23,NCAU,PC24,NCAU,PC25,NCAU,;
155                  PC26,NCAU,PC27,NCAU,PC28,NCAU,PC29,NCAU,PC30,NCAU,;
156                  PC31,NCAU,PC32,NCAU,PC33,NCAU,PC34,NCAU
157         ALLOCATE BIU01,NIOU,BIU02,NIOL,BIU03,NIOL,BIU04,NIOU,BIU05,NIOU,;
158                  BIU06,NIOU,BIU07,NIOL,BIU08,NIOL,BIU09,NIOU,BIU10,NIOU,;
159                  BIU11,NIOU,BIU12,NIOL,BIU13,NIOL,BIU14,NIOU,BIU15,NIOU,;
160                  BIU16,NIOU
161         ALLOCATE IU01,NIOU,IU02,NIOU,IU03,NIOL,IU04,NIOU,IU05,NIOU,;
162                  IU06,NIOU,IU07,NIOL,IU08,NIOL,IU09,NIOU,IU10,NIOL,;
163                  IU11,NIOU,IU12,NIOU,IU13,NIOL,IU14,NIOU,IU15,NIOU,;
164                  IU16,NIOU
165         ALLOCATE BLO01,NLO,BLO02,NLO,LO01,NLO,LO02,NLO
166         ALLOCATE BUT01,NUNITS,BUT02,NUNITS,BUT03,NUNITS,BUT04,NUNITS,;
167                  BUT05,NUNITS,BUT06,NUNITS,BUT07,NUNITS,BUT08,NUNITS,;
168                  BUT09,NUNITS
169         ALLOCATE UT01,NUNITS,UT02,NUNITS,UT03,NUNITS,UT04,NUNITS,;
170                  UT05,NUNITS,UT06,NUNITS,UT07,NUNITS,UT08,NUNITS,;
```

```
            UT?,S,?,UNIT.
ALLOCATE DAYMO,12,UFPTCC,?,RESULT,16,BGCS,32,EFAVPG,3,NOPROG,E
FLAG:=0                                    @ INITIALIZE FIRST PASS FLAG
DAYMO(1):=31                               @ TABLE OF DAYS IN MONTH
IF (SYR///4)=0                             @ LEAP YEAR?
      DAYMO(2):=29
ELSE
      DAYMO(2):=28
ENDIF
DAYMO(3):=31
DAYMO(4):=30
DAYMO(5):=31
DAYMO(6):=30
DAYMO(7):=31
DAYMO(8):=31
DAYMO(9):=30
DAYMO(10):=31
DAYMO(11):=30
DAYMO(12):=31
FOR I,0,31
      BGCS(I):=0
ENDFOR
VC01:=0                                    @ SIP RTC TIME
VC09:=0                                    @ TRANSACTION SCHEDULED
VC16:=0                                    @ SYSTEM IDLE
VC23:=0                                    @ GCS INPUT CHARACTERS
VC24:=0                                    @ GCS OUTPUT CHARACTERS
VC25:=0                                    @ GCS ACTIVE TIME
VC30:=0                                    @ DOWNED MEMORY
VC31:=0                                    @ RESIDENT EXEC MEMORY
VC32:=0                                    @ EXEC SEGMENTS MEMORY
VC33:=0                                    @ COMMON BANK MEMORY
VC34:=0                                    @ TIP MEMORY
VC35:=0                                    @ R/T MEMORY
VC36:=0                                    @ DEMAND MEMORY
VC37:=0                                    @ BATCH MEMORY
VC43:=0                                     @ DEMAND RESPONSE TIME
VC44:=0                                    @ SWAP COUNT
FOR I,0,NCAU-1                             @ LOOP FOR ALL PROCESSORS
      PC01(I):=0                           @ EXEC 0 ACTIVE TIME
      PC02(I):=0                           @ EXEC 1 ACTIVE TIME
      PC16(I):=0                           @ REAL TIME ACTIVE
      PC17(I):=0                           @ TIP ACTIVE
      PC18(I):=0                           @ DEADLINE BATCH TIME
      PC19(I):=0                           @ BATCH TIME
      PC20(I):=0                           @ DEMAND TIME
      PC22(I):=0                           @ PROCESSOR IDLE TIME
      PC23(I):=0                           @ EXEC 3 ACTIVE TIME
      IF NCAU>1                            @ MULTI PROCESSOR SYSTEM?
            PC22(I):=0                     @ ???
            PC33(I):=0                     @ EXEC T/S
            PC34(I):=0                     @ USER T/S
      ENDIF
ENDFOR
FOR I,0,NIOU-1                             @ LOOP FOR ALL IOU S
      IOU01(I):=0                          @ REQUEST THRU CHN 0
      IOU02(I):=0                          @ # 1?? WD BLKS THRU CHN ?
```

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```
              IOC02(I):=0                      & REQUEST THRU CHN 1
              IOC03(I):=0                      & # 100 WD BLKS THRU CHN 1
              IOC0?(I):=0                      & REQUEST THRU CHN 2
              IOC0?(I):=0                      & # 100 WD BLKS THRU CHN 2
              IOC07(I):=0                      & REQUEST THRU CHN 3
              IOC0?(I):=0                      & # 100 WD BLKS THRU CHN 3
              IOC0?(I):=0                      & REQUEST THRU CHN 4
              IOC10(I):=0                      & # 100 WD BLKS THRU CHN 4
              IOC11(I):=0                      & REQUEST THRU CHN 5
              IOC12(I):=0                      & # 100 WD BLKS THRU CHN 5
              IOC13(I):=0                      & REQUEST THRU CHN 6
              IOC14(I):=0                      & # 100 WD BLKS THRU CHN 6
              IOC1?(I):=0                      & REQUEST THRU CHN 7
              IOC1?(I):=0                      & # 100 WD BLKS THRU CHN 7
          ENDFOR
          FOR I,0,NLC-1                        & FOR EACH LOGICAL CHANNEL
              LCOC1(I):=0                      & REQUEST QUEUED TO LC
              LCOC2(I):=0                      & CUMULATIVE QUEUED UNITS TO LC
          ENDFOR
          FOR I,0,NUNITS-1                     & FOR ALL UNITS
              UTOC1(I):=0                      & INPUT REQUEST FOR UNIT
              UTOC2(I):=0                      & OUTPUT REQUEST FOR UNIT
              UTOC3(I):=0                      & #WDS INPUT FROM UNIT
              UTOC4(I):=0                      & # 100 WD BLK OUTPUT TO UNIT
              UTOC5(I):=0                      & DATA TRANSFER TIME
              UTOC6(I):=0                      & EXISTENCE TIME
              UTOC7(I):=0                      & REQUEST QUEUED
              UTOC8(I):=0                      & CUMULATIVE QUEUE SIZE
          ENDFOR
      END
      FUNCT LASEIV
          LASTIM:=TIMSTP[]/5000              & SET BEGINNING TIME INTERVAL
          BOPNCT:=UPDTCT[]                     & # UPDATES TO OPEN COUNTERS
          BINCCT:=SBINCT[]                     & # UPDATES TO IN CORE COUNTERS
          BC09:=SBTPX[]                        & TRANSACTIONS SCHEDULED
          BC16:=0                              & ALL CPUS IDLE TIME
          FOR I,0,NCAU-1                       & FOR ALL CPUS SUM
              BC16:=BC16+LSLTM[LSLSDL,I]       & TIME IN SYSTEM IDLE LOOP
          ENDFOR
          BC23:=0                              & ZERO GCS CHARACTERS IN
          BC24:=0                              & ZERO GCS CHARACTERS OUT
          FOR I,0,31                           & SUM CHARACTER CTS FOR ALL LINES
              J:=I*2                           & NOTE ONLY SINGLE GCS PROCESSED
              BC24:=BC24+SDCTCC[J]             & OUTPUT CHARACTER COUNTS
              J:=J+1                           & ADVANCE TO INPUT SLOT
              BC23:=BC23+SDCTCC[J]             & INPUT CHARACTER COUNTS
          ENDFOR
          BSFIUT:=0                            & ZERO SUM OF MEMORY TIME
          FOR M,0,31                           & SUM UP ACCUMULATED TIME FOR ALL
              BSFIUT:=BSFIUT+SFIUT[M]          & SIZE INTERVALS
          ENDFOR
          FOR M,0,7                            & FOR EACH MAIN STORAGE CATEGORY
              I:=2*M                           & SAVE THE TIME WEIGHTED TOTAL
              J:=I+1                           & ALLOCATED MAIN STORAGE
              SCALE SFMTCC[I],SFMTCC[J]        & GET DOUBLE WORD ENTRY AND
              BFMTCG(M):=SW                    & AND SAVE IT
              SCALE SFAVFC[I],SFAVFC[J]
```

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```
        [illegible](I):=SW
ENDFOR
[illegible]
[illegible]
FOR [illegible]
    [illegible]
ENDFOR
[illegible]                               & COMPUTE NUMBER SWAPS
FOR I,[illegible]
    [illegible]:=L[illegible]+SCSWPT[I]
ENDFOR
FOR I,0,NCAU-1                            & LOOP FOR ALL PROCESSORS
    BF[illegible](I):=LSLTM[L[illegible],I]      & EXEC 2 ACTIVE TIME
    BF[illegible](I):=LSLTM[LEXONE,I]       & EXEC 1 ACTIVE TIME
    BF16(I):=LSLTM[LRT,I]                 & REAL TIME ACTIVE
    BF17(I):=LSLTM[LTIP,I]                & TIP ACTIVE
    BF18(I):=LSLTM[LDLN,I]                & DEADLINE BATCH TIME
    BF19(I):=LSLTM[LBATCH,I]              & BATCH TIME
    BF20(I):=LSLTM[LDEM,I]                & DEMAND TIME
    BF22(I):=LSLTM[LSLPOL,I]              & PROCESSOR IDLE TIME
    BF23(I):=LSLTM[LX3,I]                 & EXEC 3 ACTIVE TIME
ENDFOR
FOR I,0,NIOU-1                            & LOOP FOR ALL IOU S
    BIU01(I):=SBCMRQ[0,I]                 & REQUEST THRU CHN 0
    SCALE SBCMWD[0,I],SBCMWD[1,I]
    BIU02(I):=SW                          & # 100 WD BLKS THRU CHN 0
    BIU03(I):=SBCMRQ[1,I]                 & REQUEST THRU CHN 1
    SCALE SBCMWD[2,I],SBCMWD[3,I]
    BIU04(I):=SW                          & # 100 WD BLKS THRU CHN 1
    BIU05(I):=SBCMRQ[2,I]                 & REQUEST THRU CHN 2
    SCALE SBCMWD[4,I],SBCMWD[5,I]
    BIU06(I):=SW                          & # 100 WD BLKS THRU CHN 2
    BIU07(I):=SBCMRQ[3,I]                 & REQUEST THRU CHN 3
    SCALE SBCMWD[6,I],SBCMWD[7,I]
    BIU08(I):=SW                          & # 100 WD BLKS THRU CHN 3
    BIU09(I):=SBCMRQ[4,I]                 & REQUEST THRU CHN 4
    SCALE SBCMWD[8,I],SBCMWD[9,I]
    BIU10(I):=SW                          & # 100 WD BLKS THRU CHN 4
    BIU11(I):=SBCMRQ[5,I]                 & REQUEST THRU CHN 5
    SCALE SBCMWD[10,I],SBCMWD[11,I]
    BIU12(I):=SW                          & # 100 WD BLKS THRU CHN 5
    BIU13(I):=SBCMRQ[6,I]                 & REQUEST THRU CHN 6
    SCALE SBCMWD[12,I],SBCMWD[13,I]
    BIU14(I):=SW                          & # 100 WD BLKS THRU CHN 6
    BIU15(I):=SBCMRQ[7,I]                 & REQUEST THRU CHN 7
    SCALE SBCMWD[14,I],SBCMWD[15,I]
    BIU16(I):=SW                          & # 100 WD BLKS THRU CHN 7
ENDFOR
FOR I,0,NUNITS-1                          & FOR ALL UNITS
    BUT01(I):=SBUREQ[0,I]                 & INPUT REQUEST FOR UNIT
    BUT02(I):=SBUREQ[1,I]                 & OUTPUT REQUEST FOR UNIT
    BUT03(I):=SBUTRN[0,I]                 & WRDS INPUT FROM UNIT
    BUT04(I):=SBUTRN[1,I]                 & # WRDS OUTPUT TO UNIT
    BUT05(I):=SBUTIM[0,I]                 & DATA TRANSFER TIME
    BUT06(I):=SBUEXT[0,I]                 & EXISTENCE TIME
    BUT07(I):=SBUQUE[0,I]                 & REQUEST QUEUED
    BUT08(I):=SBUQSZ[0,I]                 & CUMULATIVE QUEUE SIZE
```

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```
        ENDFOR
    END
    FUNCT ANALYV
        CLRTIM:=TIMSTP[2]/1000                  @ SET END TIME OF THIS INTERVAL
        V010:=INTVTM*2                          @ SET THE TIME IN THIS INTERVAL
        ACPNCT:=UPDTCT[2]-EUPACT                @ # OF TIMES OPEN COUNT UPDATED
        V020:=SBTRX[2]-BTRS                     @ # TRANS SCHEDULED
        V016:=0
        FOR I,0,NCAU-1                          @ FOR ALL CPUS SUM
            V016:=V016+LS_TM[LSLSDL,I]          @ TIME IN SYSTEM IDLE LOOP
        ENDFOR
        V016:=V016-B016                         @ THIS INTERVAL TIME IN SYSTEM IDLE LOOP
        V016:=V016*2
        V023:=0
        V024:=0
        V025:=0
        FOR I,0,1                               @ SUM FOR ALL GCS LINES
            J:=I*2                              @ NOTE ONLY SINGLE GCS PROCESSED
            IF SDCTST[J]=0                      @ WAS LINE ACTIVE THIS INTERVAL
                V025:=V025+SLCTTT[J]-BGCS(I) @ LINE ACTIVE TIME
                BGCS(I):=SLCTTT[J]              @ RESET TOTAL ACTIVE TIME
            ELSE
                V025:=V025+INTVTM               @ LINE ACTIVE TIME/INTERVAL
                BGCS(I):=BGCS(I)+INTVTM @ TOTAL TIME LINE ASSIGNED
            ENDIF
            V024:=V024+SDCTCC[J]                @ OUTPUT CHARACTER COUNTS
            J:=J+1                              @ ADVANCE TO INPUT SLOT
            V023:=V023+SDCTCC[J]                @ INPUT CHARACTER COUNTS
        ENDFOR
        V023:=V023-B023                         @ GCS CHARACTERS IN
        V024:=V024-B024                         @ GCS CHARACTERS OUT
        V025:=V025*2                            @ GCS LINE ACTIVE TIME
        MUTICS:=0                               @ ZERO SUM OF MEMORY TIME
        FOR M,0,3                               @ SUM UP ACCUMULATED TIME FOR ALL
            MUTICS:=MUTICS+SFJUT[M]             @ SIZE INTERVALS
        ENDFOR
        MUTICS:=(MUTICS-BSFILT)/01000
        FOR M,0,7                               @ FOR EACH MAIN STORAGE CATEGORY
            I:=2*M                              @ SAVE THE TIME WEIGHTED TOTAL
            J:=I+1                              @ ALLOCATED MAIN STORAGE
            SCALE SFMTCG[I],SFMTCG[J]           @ GET DOUBLE WORD ENTRY AND
            RESULT(M):=(SW-BFMTCG(M))/MUTICS @ MEMORY FOR CATEGORY
            SCALE SFAVPG[I],SFAVPG[J]
            NOPROG(M):=(100*RESULT(M))/((SW-BFAVPG(M))/MUTICS)
        ENDFOR
        V030:=RESULT(0)*64                      @ OWNED MEMORY
        V031:=RESULT(1)*64                      @ RES EXEC MEMORY
        V032:=RESULT(2)*64                      @ EXEC SEGS MEMORY
        V033:=RESULT(3)*64                      @ COMMON BANKS MEMORY
        V034:=RESULT(4)*64                      @ TIP MEMORY
        V035:=RESULT(5)*64                      @ R/T MEMORY
        V036:=RESULT(6)*64                      @ DEMAND MEMORY
        V037:=RESULT(7)*64                      @ BATCH MEMORY
        V038:=NOPROG(4)
        V039:=NOPROG(5)
        V040:=NOPROG(6)
        V041:=NOPROG(7)
```

```
BEGINFOR
FOR N,0,NOTHI
   B,44A:=B,44A+UMRSETIMC
ENDFOR
V143:=(BL43A-BU43)/(4*(DMRSPA[J-B743]))
V144:=0                                  @ COMPUTE NUMBER SWAPS
FOR J,1,7
      V144:=V144+SCSWPT[J]
ENDFOR
V144:=V144-B144                          @ NUMBER OF SWAPS
FOR I,0,NCAU-1                           @ LOOP FOR ALL PROCESSORS
      PU01(I):=(LSLTM[LXMC,I]-BP01(I))*2 @ EXEC 0 ACTIVE TIME
      PU02(I):=(LSLTM[LEXONE,I]-BP02(I))*2 @ EXEC 1 ACTIVE TIME
      PU16(I):=(LSLTM[LRT,I]-BP16(I))*2 @ REAL TIME ACTIVE
      PU17(I):=(LSLTM[LTIF,I]-BP17(I))*2 @ TIF ACTIVE
      PU18(I):=(LSLTM[LDLN,I]-BP18(I))*2 @ DEADLINE BATCH TIME
      PU19(I):=(LSLTM[LBATCH,I]-BP19(I))*2 @ BATCH TIME
      PU20(I):=(LSLTM[LDEM,I]-BP20(I))*2 @ DEMAND TIME
      PU22(I):=(LSLTM[LSLPDL,I]-BP22(I))*2 @ PROCESSOR IDLE TIME
      PU23(I):=(LSLTM[LX3,I]-BP23(I))*2    @ EXEC 3 ACTIVE TIME
ENDFOR
FOR I,0,NIOU-1                           @ LOOP FOR ALL IOU S
      IOU01(I):=SBCMRQ[0,I]-BIU01(I) @ REQUEST THRU CHN 0
      SCALE SBCMWD[0,I],SBCMWD[1,I]
      IOU02(I):=512*(SW-BIU02(I))/100 @ # 100 WD BLKS THRU CHN 0
      IOU03(I):=SBCMRQ[1,I]-BIU03(I) @ REQUEST THRU CHN 1
      SCALE SBCMWD[2,I],SBCMWD[3,I]
      IOU04(I):=512*(SW-BIU04(I))/100 @ # 512 WD BLKS THRU CHN 1
      IOU05(I):=SBCMRQ[2,I]-BIU05(I) @ REQUEST THRU CHN 2
      SCALE SBCMWD[4,I],SBCMWD[5,I]
      IOU06(I):=512*(SW-BIU06(I))/100 @ # 100 WD BLKS THRU CHN 2
      IOU07(I):=SBCMRQ[3,I]-BIU07(I) @ REQUEST THRU CHN 3
      SCALE SBCMWD[6,I],SBCMWD[7,I]
      IOU08(I):=512*(SW-BIU08(I))/100 @ # 512 WD BLKS THRU CHN 3
      IOU09(I):=SBCMRQ[4,I]-BIU09(I) @ REQUEST THRU CHN 4
      SCALE SBCMWD[8,I],SBCMWD[9,I]
      IOU10(I):=512*(SW-BIU10(I))/100 @ # 512 WD BLKS THRU CHN 4
      IOU11(I):=SBCMRQ[5,I]-BIU11(I) @ REQUEST THRU CHN 5
      SCALE SBCMWD[10,I],SBCMWD[11,I]
      IOU12(I):=512*(SW-BIU12(I))/100 @ # 100 WD BLKS THRU CHN 5
      IOU13(I):=SBCMRQ[6,I]-BIU13(I) @ REQUEST THRU CHN 6
      SCALE SBCMWD[12,I],SBCMWD[13,I]
      IOU14(I):=512*(SW-BIU14(I))/100 @ # 100 WD BLKS THRU CHN 6
      IOU15(I):=SBCMRQ[7,I]-BIU15(I) @ REQUEST THRU CHN 7
      SCALE SBCMWD[14,I],SBCMWD[15,I]
      IOU16(I):=512*(SW-BIU16(I))/100 @ # 100 WD BLKS THRU CHN 7
ENDFOR
FOR I,0,NUNITS-1                         @ FOR ALL UNITS
      UT001(I):=SBUREQ[0,I]-BUT01(I) @ INPUT REQUEST FOR UNIT
      UT002(I):=SBUREQ[1,I]-BUT02(I) @ OUTPUT REQUEST FOR UNIT
      UT003(I):=SBUTRN[0,I]-BUT03(I) @ #WDS INPUT FROM UNIT
      UT004(I):=SBUTRN[1,I]-BUT04(I) @ # 512 WD BLK OUTPUT TO UNIT
      UT005(I):=(SBUTIM[0,I]-BUT05(I))*2 @ DATA TRANSFER TIME
      UT006(I):=(SBUEXT[0,I]-BUT06(I))*2 @ EXISTENCE TIME
      UT007(I):=SBUQUE[0,I]-BUT07(I) @ REQUEST QUEUED
      UT008(I):=SBUQSZ[0,I]-BUT08(I) @ CUMULATIVE QUEUE SIZE
ENDFOR
```

```
        WRTIV                                      & WRITE OUT THIS INTERVAL'S DATA
END
FUNCT WRTIV
    IF FLAG=0                                     & CHECK IF FIRST PASS
        ACTCAU:=NCAU                              & THIS SECTION COMPUTES THE ACTUAL
        ACTIOU:=NIOU                              &   NUMBER OF CAUS AND IOUS IN THE
        FOR I,0,NCAU-1                            &   SYSTEM.
            IF PC01(I)<=0
                ACTCAU:=ACTCAU-1
            ENDIF
        ENDFOR
        FOR I,0,NIOU-1
            J:=IU001(I)+IU003(I)+IU005(I)+IU007(I)+IU009(I)+;
                IU011(I)+IU013(I)+IU015(I)
            IF J<=0                               & IF THIS UNIT IS INACTIVE
                ACTIOU:=ACTIOU-1                  &   SUBTRACT ONE FROM THE COUNT
            ENDIF
        ENDFOR
        F LOCAL,SDATE[!D6],INTVNO[!D4],"0100000",WEEKDAY[!F6],INTLEN[!D4],;
            IMEF[!D5],ACTCAU[!D3],ACTIOU[!D3],NCC[!D3],NCU[!D3],;
            NUNITS[!D3],EXECVERS[:2!F]
        FLAG:=1
    ENDIF
    OID:=2000001
    F LOCAL,SDATE[!D6],INTVNO[!D4],OID[!D8],LASTIM[!D11],CURTIM[!D11]
    OID:=OID+1
    F LOCAL,SDATE[!D6],INTVNO[!D4],OID[!D8],V001[!D11],V009[!D11],V016[!D11],;
      V022[!D11],V024[!D11],V025[!D11],V030[!D11],V031[!D11],V032[!D11]
    OID:=OID+1
    F LOCAL,SDATE[!D6],INTVNO[!D4],OID[!D8],V033[!D11],V034[!D11],;
      V035[!D11],V036[!D11],V037[!D11],V044[!D11]
    OID:=OID+1
    P LOCAL,SDATE[!D6],INTVNO[!D4],OID[!D8],V038[!D11],V039[!D11],;
    V040[!D11],V041[!D11],V042[!D11]
    FOR I,0,NCAU-1
      IF P001(I)>0                                & SKIP INACTIVE CAU
        OID:=3000001+(I*1000)
        P LOCAL,SDATE[!D6],INTVNO[!D4],OID[!D8],P001[I!D11],P002[I!D11],;
            P016[I!D11],P017[I!D11],P018[I!D11],P019[I!D11],P020[I!D11],;
             P022[I!D11],P023[I!D11]
      ENDIF
    ENDFOR
    FOR I,0,NIOU-1                                & LOOP FOR EACH IOU
      J:=IU001(I)+IU003(I)+IU005(I)+IU007(I)+IU009(I)+;
          IU011(I)+IU013(I)+IU015(I)
      IF J>0                                      & SKIP INACTIVE IOU
        OID:=4001001+(I*1000)
        P LOCAL,SDATE[!D6],INTVNO[!D4],OID[!D8],IU001[I!D11],IU002[I!D11],;
            IU003[I!D11],IU004[I!D11],IU005[I!D11],IU006[I!D11],;
            IU007[I!D11],IU008[I!D11],IU009[I!D11]
        OID:=OID+1
        P LOCAL,SDATE[!D6],INTVNO[!D4],OID[!D8],IU010[I!D11],IU011[I!D11],;
            IU012[I!D11],IU013[I!D11],IU014[I!D11],IU015[I!D11],;
            IU016[I!D11]
      ENDIF
    ENDFOR
    FOR I,0,NUNITS-1                              & LOOP FOR EACH DEVICE
```

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```
              UTC[I]=5.TOTC*(I+1)
              F LOCAL,SD/TE[1:50],INTVAG[1:50],CIDE[1:50],UTCC1[1:D11],UTCC2[1:D11],;
                  UTCC3[1:D11],UTCC4[1:D11],UTCC5[1:D11],UTCC6[1:D11],;
                  UTCC7[1:D11],UTCC8[1:D11]
           ENDFOR
      END
      FUNCTSIZE:=0                                   & SET FUNCTION SIZE TO ZERO

END TIO FIS.DAMERO
```

APPENDIX B

PROGRAM LISTING

PMS2*PMS.DRMFRU

PMS*PMS*FLS(1).DRMFRU

```
C
C------------------------------------------------------------------------
C UNIT INVOCATION NAME:   DRMFRU (DATA REDUCTION MODULE - FORTRAN
C  REDUCTION UNIT)
C
C PURPOSE:   TO CONVERT PAR REDUCED DATA TO FILES OF PERFORMANCE DATA
C  FOR USE BY THE REMAINDER OF PMS.
C
C INVOCATION METHOD:   @XQT PMS.DRMFRU
C
C   FILE/RECORD REFERENCES:
C    FILE NAME          USE                   CONTENTS
C    PMS*PARAMADEF.      I             DEFINITIONS OF PARAMETERS AND DEVICES
C                                      USED
C    PMS*OPERINPUT.      I             PMS OPERATOR INPUTS
C    PMS*IOCONFIGU.      I             I/O CONFIGURATIONS
C    PMS*PARDATAFL.      I             PERFORMANCE DATA REDUCED BY PAR
C    PMS*SPHISTORY.      O             PERFORMANCE DATA OUTPUT FILE
C    PMS*TRACER.         O             PROGRAM EXECUTION MESSAGES
C    PMS*SYSCONFIG.      O             SYSTEM CONFIGURATION DATA
C
C INTERMEDIATE VARIABLES:
C   NAME           TYPE                     DESCRIPTION
C  CNT             INT               ROW COUNTER FOR ARRAYS
C  NUMCDB          INT               NUMBER OF CDB FILES IN PARAFLNMS.
C  PERFUJ          REAL/COMMON       PER MULTIPLIER FACTOR
C  FILCDB          INT               NUMBER OF CDB FILES IN PARAMADEF.
C  DEVMNE          CHAR              DEVICE MNEMONIC FROM PARAMADEF.
C  UNIT            CHAR              DEVICE UNIT ID FROM PARAMADEF.
C  MODEL           CHAR              MODEL ID FROM PARAMADEF.
C  DATTYP          CHAR              DATA TYPE FROM PARAMADEF.
C  PARMS           INT/COMMON        ONE DIMENSIONAL ARRAY OF 15 ELEMENTS
C                                    CONTAINING CDB FILE NUMBERS FOR PARAMETERS
C  DEVDEF          CHAR/COMMON       TWO DIMENSIONAL ARRAY CONTAINING DEVICE
C                                    MNEMONIC, MODEL NO., UNIT NO. AND DATA TYPE
C                                    FOR ALL DEVICES IN PARAMADEF.
C  DEVDAT          REAL/COMMON       TWO DIMENSIONAL DEVICE DATA ARRAY
C  NUMDEV          INT/COMMON        NUMBER OF DEVICES SPECIFIED IN PARAMADEF.
C  DAYCNT          INT               NUMBER OF CYCLES TO BE REDUCED IN ONE
C                                    INVOCATION OF DRMFRU, RECORD 5 OF MISCELLAN.
C  REPDAT          CHAR              REPORT DATE FROM OPERINPUT.
C  INDATE          REAL              DATES READ IN FROM OPERINPUT.
C  STDATE          INT               START DATE OF REPORT
C  EDDATE          INT               END DATE OF REPORT
C  DAYLOP          INT               MAIN LOOP COUNTER FOR DAYS OF SIF TO BE
C                                    REDUCED
C  IOCTYP          INT/COMMON        IOCONFIGU. RECORD TYPE
C  SAVDAT          INT/COMMON        SAVED DATE
C  PARTYP          INT/COMMON        RECORD TYPE FROM PARDATAFL.
C  BLKDAT          INT/COMMON        SIF DATA BLOCK DATE
C  INTVAL          INT/COMMON        INTERVAL NUMBER FROM PARDATAFL.
C  SUBTYP          INT/COMMON        RECORD SUBTYPE FROM PARDATAFL.
C  NEXTDY          CHAR/COMMON       NEXT DAY FOUND INDICATOR
C  ELPTIM          REAL/COMMON       ELAPSED TIME READ FROM PARDATAFL.
C  PROCNM          INT/COMMON        ONE DIMENSIONAL ARRAY WITH 4 ELEMENTS
C                                    SPECIFYING PROCESSOR NUMBER IN USE
```

```
C   TOTMEM          INT/COMMON      MAIN MEMORY SIZE
C   NUMCPU          INT/COMMON      NUMBER OF CPUS CONFIGURED FOR A DAY
C   EXECVL          CHAR/COMMON     EXECUTIVE LEVEL FOR A DAY
C   DSKCNT          INT/COMMON      NUMBER OF DISKS UP
C   TIMEON          INT/COMMON      SIF DATA BLOCK TURN-ON TIME
C   TIMEOF          INT/COMMON      SIF DATA BLOCK TURN-OFF TIME
C   TIFCNT          INT/COMMON      TIF TRANSACTION COUNT
C   SYSIDL          REAL/COMMON     SYSTEM IDLE TIME
C   RESMEM          INT/COMMON      RESIDENT EXECUTIVE MEMORY SIZE
C   EXCMEM          INT/COMMON      EXECUTIVE SEGMENT MEMORY SIZE
C   COMMEM          INT/COMMON      COMMON BANK MEMORY SIZE
C   TIFMEM          INT/COMMON      TIF MEMORY SIZE
C   RELMEM          INT/COMMON      REAL TIME MEMORY SIZE
C   DEMMEM          INT/COMMON      DEMAND MEMORY SIZE
C   BATMEM          INT/COMMON      BATCH MEMORY SIZE
C   SWPCNT          INT/COMMON      SWAP COUNT
C   TIFPRG          REAL/COMMON     TIF PROGRAMS IN MEMORY
C   RTMPRG          REAL/COMMON     REAL-TIME PROGRAMS IN MEMORY
C   DMDPRG          REAL/COMMON     DEMAND PROGRAMS IN MEMORY
C   BATPRG          REAL/COMMON     BATCH PROGRAMS IN MEMORY
C   BLDATE          INT/COMMON      SIF DATA BLOCK DATE
C   IDLE            REAL/COMMON     TOTAL PROCESSOR IDLE TIME
C   PRCIDL          REAL/COMMON     PROCESSOR IDLE TIME
C   HSTARY          REAL/COMMON     ONE DIMENSIONAL ARRAY OF 122
C                                   ELEMENTS HOLDING DATA FOR SPHISTORY.
C                                   CREATION
C   ENDFIL          CHAR/COMMON     END OF PARDATAFL. INDICATOR
C   CPUCNT          INT/COMMON      COUNT OF ACTIVE CPUS
C   CDEMAX          INT/COMMON      HIGHEST PARAMADEF. COB FILE NO.
C   DMDRST          CHAR/COMMON     DEMAND RESPONSE TIME
C
C  DEVELOPMENT HISTORY
C     AUTHOR                REFERENCES          DESCRIPTION
C  R. AHOUA                                  INITIAL DRAFT   8/17/84
C
C  UNIT FLOW
C-----------------------------------------------------------------------
C  ***PROCESS 1*** READ PARAMADEF FILE AND STORE DATA IN PARMS UNTIL
C   EOF IS REACHED
C
C  RESET ROW COUNTER FOR ARRAYS, CNT, TO ZERO
C  RESET CDEMAX TO ZERO
C  INITIALIZE ALL ELEMENTS OF PARMS ARRAY TO ZEROS
C  INITIALIZE ALL ELEMENTS OF DEVDEF ARRAY TO BLANKS, " "
C  INITIALIZE ALL ELEMENTS OF DEVDAT ARRAY TO ZEROS
C  OPEN PARAMADEF.
C  READ TWO FIELDS OF FIRST RECORD INTO NUMCDE, FEPFUJ
C   ((NOTE: ALL OF THE DATA TYPES BELOW MAY NOT BE USED IN ANY
C    PARTICULAR CONFIGURATION OF PARAMADEF.))
C  DO UNTIL EOF OF PARAMADEF
C     READ FIVE FIELDS OF PRESENT RECORD OF PARAMADEF INTO FILCDE,
C      DEVMNE, UNIT, MODEL, DATTYP
C      ((NOW TEST DATA TYPE FOR PARAMETER WITH FILCDE FILE NO.))
C     IF DATTYP IS "TIFWL" ((TIP WORK LOAD, AVG JOBS IN MEMORY))
C     THEN PARMS(I) = FILCDE
C     ENDIF
C     IF DATTYP IS "DMDWL"  ((DEMAND WORK LOAD, AVG JOBS IN MEMORY))
```

```
C     THEN PARMS(2) = FILCDE
C     ENDIF
C     IF DATTYP IS "BATWL" ((BATCH WORK LOAD, AVG JOBS IN MEMORY))
C     THEN PARMS(3) = FILCDE
C     ENDIF
C     IF DATTYP IS "RELWL" ((REAL TIME WORK LOAD, AVG JOBS IN MEMORY))
C     THEN PARMS(4) = FILCDE
C     ENDIF
C     IF DATTYP IS "TIRRT" ((TIP RESPONSE TIME))
C     THEN PARMS(5) = FILCDE
C     ENDIF
C     IF DATTYP IS "CMDRT" ((COMMAND RESPONSE TIME))
C     THEN PARMS(6) = FILCDE
C     ENDIF
C     IF DATTYP IS "CPUUL" ((CPU UTILIZATION))
C     THEN PARMS(7) = FILCDE
C     ENDIF
C     IF DATTYP IS "MEMUL" ((MEMORY UTILIZATION))
C     THEN PARMS(8) = FILCDE
C     ENDIF
C     IF DATTYP IS "SWPRT" ((SWAP RATE))
C     THEN PARMS(9) = FILCDE
C     ENDIF
C     IF DATTYP IS "DIOUL" ((I/O CHANNEL UTILIZATION))
C     THEN PARMS(10) = FILCDE
C     ENDIF
C      ((CHECK TO SEE IF DATA TYPE REPPRESENTED A DEVICE.  IF SO,
C        THEN PLACE READ RECORDS INTO THE DEVICE ARRAY))
C     IF DATTYP WAS DISK UTILIZATION, "DSKUL", OR FEP WORK LOAD,
C      "FEPWL", OR DTV WORK LOAD, "DTVWL", OR OTHER DEVICE WORK
C      LOADS, "DEVWL"
C     THEN
C        INCREMENT CNT BY ONE
C        SET DEVDEF(CNT,1) TO DEVNAME
C        SET DEVDEF(CNT,2) TO MODEL
C        SET DEVDEF(CNT,3) TO UNIT
C        SET DEVDEF(CNT,4) TO DATTYP
C        SET DEVDAT(CNT,5) TO FILCDE
C     ENDIF
C     IF CODEFILE NO. IS GT MAXIMUM FILE NUMBER THUS FAR
C     THEN SET CODEFILE NO. AS THE LARGEST FILE NUMBER READ FROM PARAMADEF
C     ENDIF
C  ENDDO
C  SET NUMBER OF DEVICES, NUMDEV, TO CNT
C  CLOSE PARAMADEF.
C  ***END PROCESS 1***
C
C
C
C  ***PROCESS 2A***  READ RECORDS OF MISCELLAN. FILE
C  OPEN "MISCELLAN.
C   ((RECORD 3 OF THIS FILE CONTAINS THE NUMBER OF DAYS OF DATA))
C  READ RECORD 3 OF "MISCELLAN. INTO DAYCNT
C  CLOSE MISCELLAN.
C  IF DAYCNT EQ 0
C  THEN
C     WRITE TO TERMINAL "DEFERR FINISHED - NO DATA REDUCED THIS LOOP"
```

```
            READ (IN1,1) NUMCDE,REPDAT
     *      READ (IN1,2,ERR=95,END=955) FILCDE,DEVMNE,UNIT,MODEL,DATTYP
            TEMP=TEMP+1
            IF (DATTYP.EQ.'TIPWL') PARMS(1) = FILCDE
            IF (DATTYP.EQ.'DMILW') PARMS(2) = FILCDE
            IF (DATTYP.EQ.'DATWL') PARMS(3) = FILCDE
            IF (DATTYP.EQ.'REELWL') PARMS(4) = FILCDE
            IF (DATTYP.EQ.'TIFRT') PARMS(5) = FILCDE
            IF (DATTYP.EQ.'DMCRT') PARMS(6) = FILCDE
            IF (DATTYP.EQ.'CPLLL') PARMS(7) = FILCDE
            IF (DATTYP.EQ.'REPWL') PARMS(8) = FILCDE
            IF (DATTYP.EQ.'SWFRT') PARMS(9) = FILCDE
            IF (DATTYP.EQ.'DICLL') PARMS(10) = FILCDE

            IF ((DATTYP.EQ.'DSKWL').OR.(DATTYP.EQ.'FEPWL').OR.(
     &      DATTYP.EQ.'CTVWL').OR.(DATTYP.EQ.'DEVWL')) THEN
               CNT = CNT + 1
               DEVDEF(CNT,1) = DEVMNE
               DEVDEF(CNT,2) = MODEL
               DEVDEF(CNT,3) = UNIT
               DEVDEF(CNT,4) = DATTYP
               DEVDAT(CNT,5) = FILCDE
            ENDIF
            IF (FILCDE.EQ.29) THEN
               WRITE(10,*)'PDP2 HAS SPECIFICATION:'
               WRITE(10,*)DEVDAT(CNT,1),DEVDAT(CNT,2),DEVDAT(CNT,3),
     &          DEVDAT(CNT,4),','
            ENDIF
            IF (FILCDE.GT.CODMAX) CODMAX = FILCDE
            IF (TEMP.NE.NUMCDE) GO TO 30
   40       NUMDEV = CNT
            WRITE(10,*)'TOTAL OF ',NUMDEV,' DEVICES READ FROM PARAMDEF.'
            CLOSE (IN1,ERR=925)
C   ***END PROCESS 1***
C
C
C   ***PROCESS 2A***  READ RECORDS OF MISCELLAN. FILE
            OPEN (IN1,ERR=930,FILE='MISCELLAN.')
            READ (IN1,50) DAYCNT
            CLOSE (IN1,ERR=935)
            WRITE(10,*)'NUMBER OF CYCLES TO BE REDUCED THIS LOOP: ',DAYCNT
            IF (DAYCNT.EQ.0) GO TO 265
C   ***END PROCESS 2A***
C
C
C   ***PROCESS 2B***  READ DATES FROM OPERINPUT. FILE
            OPEN (IN1,ERR=940,FILE='OPERINPUT.')
            READ (IN1,60) REPDAT
            READ (IN1,70) INDATE
            STDATE = IFIX(INDATE*100 + 0.5)
            READ (IN1,70) INDATE
            EDDATE = IFIX(INDATE*100 + 0.5)
            CLOSE (IN1,ERR=945)
            WRITE(10,*)'REPDATE: ',REPDAT,' START DATE: ',STDATE
            WRITE(10,*)'END DATE: ',EDDATE
C   ***END PROCESS 2B***
C
```

```
C
C   ***PROCESS ****  REDUCE DATA FROM IOCONFIGU. AND PARDATAFL.
      OPEN (IN1,ERR=995,FILE='PARDATAFL.')
      OPEN (IN2,ERR=995,FILE='IOCONFIGU.')
      OPEN (IN3,ERR=995,FILE='CPHISTORY.')
      WRITE(1,*)'DRMFRL: OPENED FILES, READY TO REDUCE ',DAYCNT
      WRITE(1,*)'CYCLES OF DATA.'
 90   READ (IN2,90,ERR=995,END=997) IOCTYP
      IF (IOCTYP.NE.10) GO TO 90
      DO 140 DAYLOP=1,DAYCNT
 100     CALL DRMFR1
         WRITE(10,*)'IOCONFIGU. FILE PROCESSED SUCCESSFULLY IN DRMFR1'
         WRITE(10,*)'FOR CLOCK ',DAYLOP,'.'
         SAVDAT = 0
         IF (DAYLOP.EQ.1) THEN
 110        READ (IN1,120,ERR=970,END=977) CLKDAT,INTVAL,PARTYP,SUBTYP
            IF (PARTYP.NE.01) GO TO 110
         ENDIF
         SAVDAT = CLKDAT
         NEXTDY ='N'
         ENDFIL ='N'
 130     CALL DRMFR2
         IF ((ELPTIM.EQ.0).OR.(CLKDAT.LT.STDATE).OR.(CLKDAT.GT.EDDATE)
     &     .OR.((CLKDAT.GT.(SAVDAT+1))) THEN
           WRITE (6,*) 'DRMFRU - PAR FILE NOT IN PROPER SEQUENCE OR
     &      ELAPSED TIME OUT OF BOUNDS'
           GO TO 99999
         ELSE
           CALL DRMFR3
           CALL DRMFR4
         ENDIF
         IF ((NEXTDY.EQ.'N').AND.(ENDFIL.EQ.'N')) GO TO 130
         IF ((ENDFIL.EQ.'Y').AND.(DAYLOP.NE.DAYCNT)) GO TO 993
 140  CONTINUE
      OPEN (14,ERR=995,FILE='SYSCONFIG.')
      WRITE(14,125) TOTMEM
      WRITE(14,126) NUMCPU
      WRITE(14,127) EXLEVL
      WRITE(14,128) DSKCNT
      WRITE(10,*)'DRMFRL WRITE TO SYSCONFIG:'
      WRITE(10,*)'TOTMEM: ',TOTMEM,', NUMCPU: ',NUMCPU
      WRITE(10,*)'EXLEVEL: ',EXLEVL,', DSKCNT: ',DSKCNT,'.'
      CLOSE (14,ERR=997)
      CLOSE (IN1,ERR=995)
      CLOSE (IN2,ERR=995)
      CLOSE (IN3,ERR=995)
      WRITE(10,*)'DRMFRL: CLOSED OLD FILES'
C   ***END PROCESS ****
C
      GO TO 999
 995  FORMAT ('***DRMFRL ERROR #', A2)
C
 999  WRITE(6,9000) '999'
      WRITE(6,*)'UNEXPECTED TERMINATION OF PARAMADEF.'
      GO TO 99999
 993  WRITE (6,995) '91.'
      GO TO 99999
```

```
      915   WRITE (6,900) '915'
            GO TO 99999
      920   WRITE (6,900) '920'
            WRITE (6,*) 'FAILURE TO READ PARAMADEF. FILE'
            GO TO 99999
      925   WRITE (6,900) '925'
            GO TO 99999
      930   WRITE (6,900) '930'
            GO TO 99999
      935   WRITE (6,900) '935'
            GO TO 99999
      940   WRITE (6,900) '940'
            GO TO 99999
      945   WRITE (6,900) '945'
            GO TO 99999
      950   WRITE (6,900) '950'
            GO TO 99999
      955   WRITE (6,900) '955'
            GO TO 99999
      960   WRITE (6,900) '960'
            GO TO 99999
      965   WRITE (6,900) '965'
            WRITE (6,*) 'FAILURE TO READ IOCONFIGL. FILE'
            GO TO 99999
      967   WRITE (6,900) '967'
            WRITE (6,*) 'UNEXPECTED TERMINATION OF IOCONFIGL. FILE'
            GO TO 99999
      970   WRITE (6,900) '970'
            WRITE (6,*) 'FAILURE TO READ PARDATAFL. FILE'
            GO TO 99999
      973   WRITE (6,900) '973'
            WRITE (6,*) 'PARDATAFL. DOES NOT EXIST.'
            GO TO 99999
      975   WRITE (6,900) '975'
            GO TO 99999
      980   WRITE (6,900) '980'
            GO TO 99999
      985   WRITE (6,900) '985'
            GO TO 99999
      990   WRITE (6,900) '990'
            GO TO 99999
      993   WRITE(6,900) '993'
            WRITE(6,*)'DPMFR2: UNEXPECTED TERMINATION OF PARDATAFL.'
            GO TO 99999
      995   WRITE (6,900) '995'
            GO TO 99999
      997   WRITE (6,900) '997'
            GO TO 99999
      998   PRINT *,' DPMFR0 FINISHED - NO DATA REDUCED THIS LOOP'
      999   PRINT *,'**********SUCCESSFUL EXECUTION OF DPMFR0**********'
            WRITE(*,*)'SUCCESSFUL EXECUTION OF DPMFR1'
            CLOSE (10,ERR=9998)
            GO TO 9999
     9998   CALL PSETC (4HE)
            WRITE(*,*)'DPMFR1 EXECUTION HALTED'
     9999   STOP
            END
```

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C
C
C
C
C-------------------------------------------------------------------------
C  SUBROUTINE DRVER1  (DATA REDUCTION MODULE - FORTRAN REDUCTION 1)
C
C  PURPOSE:    TO PROCESS IOCONFIGU.
C              THIS MODULE READS IOCONFIGU. FOR ONE DAY TO BUILD PART OF
C              THE DEVDAT ARRAY.
C
C  INVOCATION METHOD:  CALL PRS.DRVER1
C
C  FILE/RECORD REFERENCES:
C   FILE NAME              USE              DESCRIPTION
C   PRS*IOCONFIGU.          1          I/O CONFIGURATION FILE
C
C  LOCAL VARIABLES:
C    NAME                TYPE              DESCRIPTION
C    IOID                INT           UNIT NUMBER OF IOCONFIGU.
C    IOMNEM              CHAR          DEVICE MNEMONIC FROM IOCONFIGU.
C    IOUNIT              CHAR          I/O UNIT NUMBER
C    IOMODL              CHAR          MODEL CODE FOR THE DEVICE
C    IOSTAT              INT           UP OR DOWN STATUS OF THE DEVICE
C    DEVFND              CHAR          DEVICE FOUND INDICATOR FLAG
C
C  UNIT FLOW
C-------------------------------------------------------------------------
C
C  INITIALIZE IOCTYP TO ?
C   ((FIND NEXT HEADER RECORD OF IOCONFIGU., HAVING IOCTYP OF 1C))
C  DO UNTIL IOCTYP=1C OR EOF ((NORMAL EXITS)), OR ERROR CONDITION
C     READ IOCTYP FROM IOCONFIGU. ((FORMAT (12X,I2) ))
C     IF IOCTYP = C?
C     THEN
C          ((RE-READ RECORD FROM BUFFER.  THIS CAN BE DONE BY READING FROM
C           UNIT NUMBER ZERO))
C        READ FIELDS OF CURRENT RECORD OF IOCONFIGU. INTO IOID, IOMNEM,
C         IOUNIT, IOMODL, AND IOSTAT  ((FORMAT (17X, I3, 19X, A3, 2X, A1,
C          A6, 5X, I1) ))
C        SET DEVICE FOUND INDICATOR, DEVFND, TO "N"
C        DO (FOR CNT=1 TO NUMBER OF DEVICES, NUMDEV) OR (UNTIL DEVFND="Y")
C            ((MATCH THE DEVICE IN IOCONFIGU. WITH THE DEVICE IN THE
C              DEVDEF ARRAY.  WHEN A MATCH IS FOUND, SAVE THE UP/DOWN STATUS
C              AND SET THE NEXT UNUSED DEVDAT ELEMENT TO THE UNIT NUMBER
C              READ FROM IOCONFIGU.))
C           IF (DEVDEF(CNT,1) = IOMNEM) AND (DEVDEF(CNT,2) = IOMODL)
C            AND (DEVDEF(CNT,3) = IOUNIT)
C           THEN
C              SET UP/DOWN CODE IN DEVDAT(CNT,6) TO IOSTAT
C              SET DEVFND TO "Y"
C               ((SET THE SEVEN ALTERNATIVE DEVICE NUMBERS OF DEVDAT))
C              IF DEVICE NUMBER IN DEVDAT(CNT,1) HAS NOT YET BEEN SET,
C               STILL ?,
C              THEN SET DEVDAT(CNT,1) TO IOID
C              ELSE
C                 IF DEVDAT(CNT,2) = ?
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C                  THEN SET DEVDAT(CNT,3) TO IOIC
C                  ELSE
C                     IF DEVDAT(CNT,5) =
C                     THEN SET DEVDAT(CNT,3) TO IOID
C                     ELSE
C                        IF DEVDAT(CNT,4) = '
C                        THEN SET DEVDAT(CNT,4) TO IOIC
C                        ELSE
C                           IF DEVDAT(CNT,12) = '
C                           THEN SET DEVDAT(CNT,12) TO IOIL
C                           ELSE
C                              IF DEVDAT(CNT,14) = '
C                              THEN SET DEVDAT(CNT,14) TO IOID
C                              ELSE
C                                 IF DEVDAT(CNT,15) = '
C                                 THEN SET DEVDAT(CNT,15) TO IOIL
C                                 ELSE SET DEVDAT(CNT,16) TO IOID
C                                 ENDIF ((FOR ALTERNATE #6))
C                              ENDIF ((FOR ALTERNATE # 5))
C                           ENDIF ((FOR ALTERNATE #4))
C                        ENDIF ((FOR ALTERNATE #3))
C                     ENDIF ((FOR ALTERNATE #2))
C                  ENDIF((FOR ALTERNATE #1))
C               ENDIF ((FOR DEVICE NUMBER))
C            ENDIF
C         ENDDO
C      ENDIF
C  ENDDO
C  RETURN
C-----------------------------------------------------------------------
C  CODE
C-----------------------------------------------------------------------
      SUBROUTINE DRMFR1
C
C     **LOCAL DECLARATIONS**
      INTEGER    IOIB,IOSTAT,CNT,IOCTYP
      CHARACTER IOMNEM*2,IOUNIT*1,IOMODL*6,DEVFND*1
C     **GLOBAL DECLARATIONS**
      INTEGER    SAVDAT,PARTYP,ELADAT,INTVAL,CPUCNT,PROCNM(4),TOTMEM
      INTEGER    TIMEON,TIMEOF,TIPCNT,REXMEM,EXCMEM,COMMEM,TIPMEM,RELMEM
      INTEGER    NUMDEV,DEFMEM,BATMEM,SWPCNT,BLDATE,PARMS(15),CCBMAX
      INTEGER    NUMCPU,DSKCNT,IN,IN1,IN2,IN3
      REAL       FEPFUJ,ELPTIM,SYSIDL,TIPPRG,DEVDAT(99,16)
      REAL       RTMPRG,CMCPRC,DATPRG,PRGIDL,HSTART(102)
      CHARACTER DEVDEF(99,4)*8,NEXTDY*1,EXLEVL*12,ENDFIL*1
      COMMON     FEPFUJ,PARMS,DEVDEF,DEVDAT,NUMDEV,SAVDAT,CPUCNT,ENDFIL
      COMMON     PARTYP,ELADAT,INTVAL,NEXTDY,ELPTIM,PROCNM,TOTMEM,DSKCNT
      COMMON     NUMCPU,EXLEVL,TIMECN,TIMEOF,TIPCNT,SYSIDL,REXMEM,EXCMEM
      COMMON     COMMEM,TIPMEM,RELMEM,DEFMEM,BATMEM,SWPCNT,TIPPRG,RTMPRG
      COMMON    CMCPRC,DATPRG,BLDATE,PRGIDL,HSTART,IN,IN1,IN2,IN3,CCBMAX
      COMMON     CMCPST
C
 211  FORMAT(1X,I7)
 222  FORMAT(17X,I2,19X,A6,2X,A1,A6,5X,I1)
C
      IOCTYP = 0
      DO 25 CNT=1,NUMDEV
```

```
                DEVDAT(CNT,1)=0.0
                DEVDAT(CNT,2)=0.0
                DEVDAT(CNT,3)=0.0
                DEVDAT(CNT,4)=0.0
                DEVDAT(CNT,13)=0.0
                DEVDAT(CNT,14)=0.0
                DEVDAT(CNT,15)=0.0
                DEVDAT(CNT,16)=0.0
250   CONTINUE
260   READ (IN2,210,ERR=666,END=240) IOCTYP
      IF (IOCTYP.EQ.'25') THEN
          READ (5,220) IOID,IOMNEM,IOUNIT,IOMODL,IOSTAT
          DEVFND = 'N'
          DO 300 CNT=1,NUMDEV
              IF ((DEVDEF(CNT,1).EQ.IOMNEM).AND.(DEVDEF(CNT,2).EQ.
     &            IOMODL).AND.(DEVDEF(CNT,3).EQ.IOUNIT)) THEN
                  DEVDAT(CNT,6) = IOSTAT
                  DEVFND = 'Y'
                  IF (DEVDAT(CNT,1).EQ.0.0) THEN
                      DEVDAT(CNT,1) = IOID
                  ELSE
                      IF (DEVDAT(CNT,2).EQ.0.0) THEN
                          DEVDAT(CNT,2) = IOID
                      ELSE
                          IF (DEVDAT(CNT,3).EQ.0.0) THEN
                              DEVDAT(CNT,3) = IOID
                          ELSE
                              IF (DEVDAT(CNT,4).EQ.0.0) THEN
                                  DEVDAT(CNT,4) = IOID
                              ELSE
                                  IF (DEVDAT(CNT,13).EQ.0.0) THEN
                                      DEVDAT(CNT,13) = IOID
                                  ELSE
                                      IF (DEVDAT(CNT,14).EQ.0.0) THEN
                                          DEVDAT(CNT,14) = IOID
                                      ELSE
                                          IF (DEVDAT(CNT,15).EQ.0.0) THEN
                                              DEVDAT(CNT,15) = IOID
                                          ELSE
                                              DEVDAT(CNT,16) = IOID
                                          ENDIF
                                      ENDIF
                                  ENDIF
                              ENDIF
                          ENDIF
                      ENDIF
                  ENDIF
              ENDIF
              IF (DEVFND.EQ.'Y') GO TO 325
300       CONTINUE
325   ENDIF
      IF (IOCTYP.NE.'0') GO TO 260
240   RETURN
666   CALL FSETC (440)
      STOP
      END
C
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C
C
C
C-----------------------------------------------------------------------
C  SUBROUTINE DRIFC (DATA REDUCTION MODULE - FORTRAN REDUCTION 3)
C
C  PURPOSE:    TO PROCESS PARDATAFL.  THIS MODULE READS ALL THE INFORMATION
C              FOR ONE BLOCK OF DATA (1 MINUTE PERIOD) INTO THE DEVDAT
C              ARRAY AND SETS OTHER VARIABLES IN PREPARATION FOR THE
C              COMPUTATIONS WHICH WILL FOLLOW.
C
C  INVOCATION METHOD:  CALL FMS.DRMFC
C
C  FILE/RECORD REFERENCES:
C   FILE NAME           USE                 DESCRIPTION
C   FMS*PARDATAFL.       I          DATA REDUCED FROM PAR
C
C  LOCAL VARIABLES:
C   NAME                TYPE                DESCRIPTION
C    OLDINT             INT          OLD INTERVAL NUMBER FROM PARDATAFL.
C   SDEVUN              INT          DEVICE UNIT NUMBER
C   SINREQ              INT          INPUT REQUESTS
C   SOTREQ              INT          OUTPUT REQUESTS
C   SDATTM              REAL         DATA TRANSFER TIME
C   SEXTIM              REAL         EXISTENCE TIME
C   SREQUE              INT          NUMBER OF REQUESTS QUEUED
C   SCUMSZ              INT          CUMULATIVE QUEUE SIZE
C
C  UNIT FLOW
C-----------------------------------------------------------------------
C
C  INITIALIZE PROIDL TO 0
C  SET OLDINT = INTVAL
C   ((CLEAR OUT DEVDAT ARRAY COLUMNS CORRESPONDING TO TOTAL REQUESTS IN,
C    TOTAL REQUESTS OUT, EXISTENCE TIME, AND DATA TRANSFER TIME: COLUMNS
C    7-12))
C  DO FOR CNT=1 TO NUMBER OF DEVICES, NUMDEV
C     DO FOR COL=7 TO 12
C        INITIALIZE DEVDAT(CNT,COL) TO 0
C     ENDDO
C  ENDDO
C  CLEAR ALL FOUR ELEMENTS OF PROGRM ARRAY
C  INITIALIZE CPUCNT, ELEMENT COUNTER OF PROGRM, TO 0
C   ((WHEN INTVAL EXCEEDS OLDINT, A CLOCK HAS BEEN COMPLETED))
C  DO WHILE INTVAL IS EQ TO OLDINT
C      ((CHECK TO SEE IF PARDATAFL. HEADER IS BEING LOOKED AT))
C     IF RECORD TYPE, PARTYP, EQ 01
C      ((RE-READ FROM BUFFER PARAMETERS FROM PARDATAFL. HEADER))
C     THEN READ PARDATAFL. AGAIN, INTO: TOTMEM, NUMCPU, EXLEVL
C      ((FORMAT (12X, I1, 1X, I2, 47X, A12) ))
C     ENDIF
C     IF (PARTYP = 2) AND (SUBTYP = 1)
C      ((RE-READ FROM BUFFER WITH AN APPROPRIATE FORMAT WHICH TAKES 'S TO
C       THE DESIRED PARAMETER OF RECORD.  THE FOLLOWING FIVE IF STATEMENTS
C       ARE ALSO STRUCTURED UPON THIS BASIS))
C     THEN READ PARDATAFL. AGAIN, INTO: TIMEON, TIMEOF  ((FORMAT (12X, I11,
C      1X, I11) ))
```

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C     ENDIF
C     IF (PARTYP = 3) AND (SUBTYP = 2)
C     THEN READ PARDATAFL, AGAIN, INTO: ELAPTIM, TIPCNT, SYSIDL, REXMEM,
C      CYCMEM  ((FORMAT ('0'), F11.4, 1X, I11, 1X, F11.4, 49X, I11,
C       1X, I11) ))
C     ENDIF
C     IF (PARTYP = 3) AND (SUBTYP = 3)
C     THEN READ PARDATAFL, AGAIN, INTO: COMMEM, TIPMEM, RELMEM, DEMMEM,
C      BATMEM, SWPCNT  ((FORMAT (21X, I11, 1X, I11, 1X, I11, 1X, I11) ))
C     ENDIF
C     IF (PARTYP = 3) AND (SUBTYP = 4)
C     THEN READ PARDATAFL, AGAIN, INTO: TIPPRC, RTMPRG, DMDPRG, BATPRG,
C       PRORST
C      ((FORMAT(21X, F11.2, 1X, F11.2, 1X, F11.2, 1X, F11.2, 1X, F11.2)))
C     ENDIF
C     IF PARTYP = 2
C     THEN
C        INCREMENT CPUCNT BY 1
C         ((FOLLOWING READ DONE WITH FORMAT (16, 11A, I3, 85X, F11.4) ))
C        READ PARDATAFL, AGAIN, INTO: BLDATE, PROCNM(CPUCNT), IDLE
C         ((UPDATE PROCESSOR IDLE TIME))
C        PROIDL = PROIDL + IDLE
C     ENDIF
C     IF PARTYP = 5  ((A DEVICE))
C     THEN
C         ((FOLLOWING READ DONE WITH FORMAT (17X, I3, 1X, I11, 1X, I11,
C          25X, F11.4, 1X, F11.4, 1X, I11, 1X, I11) ))
C        READ PARDATAFL, AGAIN, INTO: SDVEUN, SINREQ, SOTREQ, SDATTM,
C         SEXTIM, SREQUD, SCUMSZ
C         ((CHECK TO FIND DEVICE UNIT NUMBER, SDVEUN, IN DEVDAT DEVICE
C          NUMBER OF THE 7 ALTERNATIVE DEVICE NUMBERS))
C         DO FOR CNT=1 TO NUMBER OF DEVICES, NUMDEV
C            IF (DEVDAT(CNT,1) = SDEVUN)
C              OR (DEVDAT(CNT,2) = SDEVUN)
C              OR (DEVDAT(CNT,3) = SDEVUN)
C              OR (DEVDAT(CNT,4) = SDEVUN)
C              OR (DEVDAT(CNT,13) = SDEVUN)
C              OR (DEVDAT(CNT,14) = SDEVUN)
C              OR (DEVDAT(CNT,15) = SDEVUN)
C              OR (DEVDAT(CNT,16) = SDEVUN)
C            THEN
C               UPDATE TOTAL REQUESTS IN, DEVDAT(CNT,7) BY ADDING
C                SINREQ TO IT
C               UPDATE TOTAL REQUESTS OUT, DEVDAT(CNT,8) BY ADDING
C                SOTREQ TO IT
C               UPDATE CUMULATIVE QUEUE SIZE, DEVDAT(CNT,9), BY ADDING
C                SCUMSZ TO IT
C               UPDATE NO. OF REQUESTS QUEUED, DEVDAT(CNT,10), BY ADDING
C                SREQUD TO IT
C               UPDATE EXISTENCE TIME, DEVDAT(CNT,11), BY ADDING
C                SEXTIM TO IT
C               UPDATE DATA TRANSFER TIME, DEVDAT(CNT,12) BY ADDING
C                SDATTM TO IT
C            ENDIF
C         ENDDO
C      ENDIF
C      READ NEXT PARDATAFL, RECORD INTO: ELAPDAT, INTVAL, PARTYP, SUBTYP
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```
C       ((FORMAT (I6, 1A, I4, 1X, I2, 2X, I2) ))
C       (( IF WE GET TO ANOTHER HEADER IN PARDATAFL., ONE DAY OF DATA HAS
C        BEEN PROCESSED))
C      IF END OF PARDATAFL.,  SET ENDFIL FLAG TO "Y" AND EXIT (RETURN)
C      IF PARTYP = 1
C      THEN SET NEXTDY TO "Y"
C  ENDDO
C  RETURN
C
C
C  ------------------------------------------------------------------
C  CODE
C  ------------------------------------------------------------------
       SUBROUTINE ORDER2
C
C     **LOCAL DECLARATIONS**
       INTEGER OLDINT,SOLVUN,SINREQ,SOTREQ,SKEWUD,SCUNSZ,CNT,COL,SUBTYP
       REAL    SEATTM,SEXTIM,IDLE
C     **GLOBAL DECLARATIONS**
       INTEGER   SAVDAT,PARTYP,BLKDAT,INTVAL,CPUCNT,PROCNM(4),TOTMEM
       INTEGER   TIMEON,TIMEOF,TIPCNT,REXMEM,EXCMEM,COMMEM,TIPMEM,RELMEM
       INTEGER   NUMDEV,DEFMEM,BATMEM,SWPCNT,BLDATE,PARMS(15),CDBMAX
       INTEGER   NUMCPU,DSKCNT,IN,IN1,IN2,IN3
       REAL      FEPFUD,ELPTIM,SYSIDL,TIPPRG, DEVDAT(99,16)
       REAL      RTMPRG,CMDPRG,BATPRG,PROIDL,HSTARY(102)
       CHARACTER DEVDEF(99,4)*6,NEXTDY*1,EXLEVL*12,ENDFIL*1
       COMMON    FEPFUD,PARMS,DEVDEF,DEVDAT,NUMDEV,SAVDAT,CPUCNT,ENDFIL
       COMMON    PARTYP,BLKDAT,INTVAL,NEXTDY,ELPTIM,PROCNM,TOTMEM,DSKCNT
       COMMON    NUMCPU,EXLEVL,TIMEON,TIMEOF,TIPCNT,SYSIDL,REXMEM,EXCMEM
       COMMON    COMMEM,TIPMEM,RELMEM,DEMMEM,BATMEM,SWPCNT,TIPPRG,RTMPRG
       COMMON    CMDPRG,BATPRG,BLDATE,PROIDL,HSTARY,IN,IN1,IN2,IN3,CDBMAX
       COMMON    CMDRST
C
 340   FORMAT(32X,I6,1X,I2,17X,A12)
 350   FORMAT(21X,I11,1X,I11)
 360   FORMAT(21X,F11.4,1X,I11,1X,F11.4,49X,I11,1X,I11)
 370   FORMAT(21X,I11,1X,I11,1X,I11,1X, I11,1X,I11,1X,I11)
 380   FORMAT(21X,F11.2,1X,F11.2,1X,F11.2,1X,F11.2,1X,F11.2)
 390   FORMAT(16,11X,I2,85X,F11.4)
 400   FORMAT(17X,I3,1X,I11,1X,I11,25X,F11.4,1X,F11.4,1X,I11,1X,I11)
 430   FORMAT(16,1X,I4,1X,I2,3X,I3)
C
       PROCNM(1) = 0
       PROCNM(2) = 0
       PROCNM(3) = 0
       PROCNM(4) = 0
       CPUCNT    = 0
       PROIDL    = 0.0
       OLDINT = INTVAL
       DO 20 CNT=1,NUMDEV
          DO 10 COL=7,1,-
             DEVDAT(CNT, COL) = 0.0
 10       CONTINUE
 20    CONTINUE
       IF (PARTYP.EQ.01) THEN
          READ (4,340) TOTMEM,NUMCPU,EXLEVL
       ENDIF
```

```
            IF ((PARTYP.EQ.1).AND.(SUBTYP.EQ.1)) THEN
               READ (1,35_) TIMEON,TIMEOF
            ENDIF
            IF ((PARTYP.EQ._).AND.(SUBTYP.EQ.2)) THEN
               READ (1,3__) ELPTIM,TIPCNT,SYSIDL,REATMEM,EACMEM
            ENDIF
            IF ((PARTYP.EQ.1).AND.(SUBTYP.EQ.3)) THEN
               READ (1,3__) COMMEM,TIPMEM,RELMEM,LENMEM,BATMEM,SWPCNT
            ENDIF
            IF ((PARTYP.EQ.2).AND.(SUBTYP.EQ.4)) THEN
               READ (1,3__) TIPPRC,RTMPRC,DMCPPC,BATPRC,DMCRST
            ENDIF
            IF (PARTYP.EQ.2) THEN
               CPUCNT = CPUCNT + 1
               READ (1,39L) ELDAT_,PROCNM(CPUCNT),IDLE
               PRCIDL = PRCIDL + IDLE
            ENDIF
            IF (PARTYP.EQ.5) THEN
               READ (1,4__) SDEVUN,SINREQ,SOTREQ,SDATTM,SEXTIM,SREQUD,SCUMSZ
               DO 41_ CNT=1,NLMLEV
                  IF ((DEVDAT(CNT,1).EQ.SDEVUN)
     &              .OR. (DEVDAT(CNT,2).EQ.SDEVUN)
     &              .OR. (DEVDAT(CNT,3).EQ.SDEVUN)
     &              .OR. (DEVDAT(CNT,4).EQ.SDEVUN)
     &              .OR. (DEVDAT(CNT,13).EQ.SDEVUN)
     &              .OR. (DEVDAT(CNT,14).EQ.SDEVUN)
     &              .OR. (DEVDAT(CNT,15).EQ.SDEVUN)
     &              .OR. (DEVDAT(CNT,16).EQ.SDEVUN)) THEN
                     DEVDAT(CNT,7) = DEVDAT(CNT,7) + SINREQ
                     DEVDAT(CNT,8) = DEVDAT(CNT,8) + SOTREQ
                     DEVDAT(CNT,9) = DEVDAT(CNT,9) + SCUMSZ
                     DEVDAT(CNT,10) = DEVDAT(CNT,10) + SREQUD
                     DEVDAT(CNT,11) = DEVDAT(CNT,11) + SEXTIM
                     DEVDAT(CNT,12) = DEVDAT(CNT,12) + SDATTM
                  ENDIF
  41_          CONTINUE
            ENDIF
            READ(IN1,42_,END=43_) BLKDAT,INTVAL,PARTYP,SUBTYP
            IF (PARTYP.EQ.31) NEXTDY = 'Y'
            IF (INTVAL.EQ.OLDINT) GO TO 33_
            GO TO 44_
  43_       ENDFIL = 'Y'
  44_       RETURN
            END
C
C
C
C
C-----------------------------------------------------------------------
C  PURPOSE:       TO COMPLETE THE HSTARY ARRAY WHICH WILL BE OUTPUTED TO
C                 SPREADSHEET FILE
C
C  INVOCATION METHOD:  CALL PAS,DRPERF
C
C  FILE/RECORD REFERENCES:
C   FILE NAME          USE              DESCRIPTION
C
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C  LOCAL VARIABLES:
C    NAME                TYPE            DESCRIPTION
C    TMOF                REAL            TIMEOF CONVERTED TO REAL NUMBER
C    TMON                REAL            TIMEON CONVERTED TO REAL NUMBER
C    DSKTRN              REAL            TOTAL DISK TRANSFER TIME
C    TOTREQ              REAL            TOTAL NUMBER OF REQUESTS
C    DEVTIM              REAL            DEVICE TIME
C    TRUQLN              REAL            TRUE QUEUE LENGTH
C    TRUSER              REAL            TRUE SERVICE TIME
C    DISKCNT             INT/COMMON      COUNTER OF DISKS UP
C
C UNIT FLOW
C-----------------------------------------------------------------------
C
C INITIALIZE ALL ELEMENTS OF HSTARY ARRAY TO -1.0, SYMBOL OF MISSING DATA
C CONVERT TIMEON FROM SEC. TO HR. REPRESENTATION, RESULT IN TMON
C CONVERT TIMEOF FROM SEC. TO HR. REPRESENTATION, RESULT IN TMOF
C   ((ADJUST FOR FAILURE TO RESET SIP AFTER 24 HOURS))
C SET HSTARY(1) TO TMON MINUS NUMBER OF HRS. PAST 24 HRS.
C SET HSTARY(2) TO TMOF MINUS NUMBER OF HRS. PAST 24 HRS.
C COMPUTE DATE OF THE DAY BEING PROCESSED IN THE FORM YYMM.DD FROM SAVDAT
C  AND TMON AND SAVE IN HSTARY(3)
C   ((HENCE FORTH ELEMENTS OF HSTARY ARRAY WILL BE REFERENCED AS THREE
C    PLUS THE ARRAY COUNTER TO TAKE INTO ACCOUNT THE THREE ELEMENTS ALREADY
C    CREATED))
C IF PARMS(1) HAS BEEN SET TO A CDB FILE NO., NO LONGER EQ TO 0
C THEN COMPUTE TIP THRUPUT AS THE QUOTIENT OF TIP TRANSACTION COUNT,
C  TIPCNT, AND ELAPSED TIME, ELPTIM, RESULT IN HSTARY(PARMS(1)+3)
C ENDIF
C IF PARMS(2) HAS BEEN SET TO A CDB FILE NO., NO LONGER EQ TO 0
C THEN SET HSTARY(PARMS(2)+3) TO AVERAGE NUMBER OF DEMAND JOBS IN MEMORY,
C  DMDPRG
C ENDIF
C IF PARMS(3) HAS BEEN SET TO A CDB FILE NO., NO LONGER EQ TO 0
C THEN SET HSTARY(PARMS(3)+3) TO AVERAGE NUMBER OF BATCH PROGRAMS IN
C  MEMORY, BATPRG
C ENDIF
C IF PARMS(4) HAS BEEN SET TO A CDB FILE NO., NO LONGER EQ TO 0
C THEN SET HSTARY(PARMS(4)+3) TO AVERAGE NUMBER OF REAL TIME PROGRAMS
C  IN MEMORY, RTMPRG
C ENDIF
C IF PARMS(5) HAS BEEN SET TO A CDB FILE NO., NO LONGER EQ TO 0
C THEN
C     ((MAKE SURE DIVISION BY ZERO DOES NOT HAPPEN))
C    IF TIPCNT NE ZERO
C    THEN COMPUTE TIP RESPONSE TIME AS (TIPPRG * ELPTIM) / TIPCNT,
C       RESULT IN HSTARY(PARMS(5)+3)
C    ENDIF
C ENDIF
C IF PARMS(6) HAS BEEN SET TO A CDB FILE NO., NO LONGER EQ TO 0
C THEN HSTARY(PARMS(6)+3) = DMDRST (DEMAND RESPONSE TIME)
C ENDIF
C IF PARMS(7) HAS BEEN SET TO A CDB FILE NO., NO LONGER EQ TO 0
C THEN COMPUTE CPU UTILIZATION AS 100 * (1-((SYSIDL+PROIDL)/CPUCNT) /
C  ELPTIM), RESULT IN HSTARY(PARMS(7)+3)
C ENDIF
C IF PARMS(8) HAS BEEN SET TO A CDB FILE NO., NO LONGER EQ TO 0
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C  THEN COMPUTE MEMORY UTILIZATION AS 1.0-((FREMEM+BCMEM+COMMEM+TIPMEM+
C   RELMEM+DEFMEM+BATMEM)/TOTMEM), RESULT IN HSTARY(PARMS(6)+3)
C  ENDIF
C  IF PARMS(9) HAS BEEN SET TO A DSK FILE NO., NO LONGER EQ TO 1
C  THEN COMPUTE THE SWAP RATE AS SWPCNT / ELPTIM, RESULT IN
C   HSTARY(PARMS(9)+3)
C  ENDIF
C  IF PARMS(10) HAS BEEN SET TO A DSK FILE NO., NO LONGER EQ TO 1
C  THEN
C     INITIALIZE TOTAL DISK TRANSFER TIME, DSKTRN, TO 0
C     INITIALIZE DISK COUNTER, DSKCNT, TO ZERO
C      ((CALCULATE TOTAL DISK TRANSFER TIME))
C     DO FOR CNT=1 TO TOTAL NUMBER OF DEVICES, NUMDEV,
C        IF (DATA TYPE IN (DEVDEF(CNT,4) IS "DSKUL") AND (IOSTAT,
C         DEVDAT(CNT,6), IS UP, EQ TO 1)
C        THEN
C           ADD TO DSKTRN THE NEW DATA TRANSFER TIME IN DEVDAT(CNT,12)
C           INCREMENT DISK COUNTER, DSKCNT, BY 1
C        ENDIF
C     ENDDO
C     COMPUTE I/O CHANNEL UTILIZATION AS (DSKTRN*0.5*100) / ELPTIM, RESULT
C      IN HSTARY(PARMS(10)+3)
C  ENDIF
C  DO FOR CNT=1 TO NUMDEV
C     COMPUTE TOTAL NUMBER OF REQUESTS, TOTREQ, BY SUMMING INPUT REQUESTS,
C      DEVDAT(CNT,7), AND OUTPUT REQUESTS, DEVDAT(CNT,8)
C      ((COMPUTE DEVICE UTILIZATION/THRUPUT FOR DTV AND OTHER I/O DEVICES
C       UP))
C     IF (DEVDEF(CNT,4) IS "DTV-L") OR (DEVDEF(CNT,4) IS "DEVWL")
C      AND DEVDAT(CNT,6) IS UP, EQ TO 1)
C     THEN COMPUTE DEVICE UTILIZATION/THRUPUT AS TOTREQ DIVIDED BY ELPTIM,
C      RESULT IN HSTARY(DEVDAT(CNT,5)+3)
C     ELSE CLEAR HSTARY(DEVDAT(CNT,5)+3)
C     ENDIF
C      ((COMPUTE DEVICE UTILIZATION/THRUPUT FOR FEPS UP))
C     IF (DEVDEF(CNT,4) IS "FEPWL")
C     THEN
C        IF (DEVDAT(CNT,6) IS UP, EQ TO 1)
C        THEN COMPUTE DEVICE UTIL. THRUPUT :(TOTREQ*FEPPUJ) / ELPTIM,
C         RESULT IN HSTARY(DEVDAT(CNT,5)+3)
C        ELSE CLEAR HSTARY(DEVDAT(CNT,5)+3)
C        ENDIF
C      ENDIF
C      ((COMPUTE DEVICE UTILIZATION/THRUPUT FOR DISKS UP))
C     IF DEVDEF(CNT,4) IS "DSKUL"
C     THEN
C        IF DEVDAT(CNT,6) IS UP, EQ TO 1
C        THEN
C           COMPUTE DEVICE TIME, DEVTIM, AS SUM OF EXISTENCE TIME,
C            DEVDAT(CNT,11), AND DATA TRANSFER TIME, DEVDAT(CNT,12)
C           IF (TOTAL NUMBER OF REQUESTS, TOTREQ, NE 0) AND (NUMBER OF
C            REQUESTS QUEUED, DEVDAT(CNT,17), NE 0)
C           THEN CALCULATE TRUE QUEUE LENGTH, TRUQLN, AS
C            1 + (DEVDAT(CNT,9)/(DEVDAT(CNT,12)-11))*(DEVDAT(CNT,16)/TOTREQ)
C           ELSE SET TRUQLN TO 1 AS QUEUE IS EMPTY
C           ENDIF
C           IF TOTREQ NE 0
```

```
C           THEN COMPUTE THE SERVICE TIME, TRUSER, AS DEVICE TIME, DEVTIM,
C            DIVIDED BY THE QUOTIENT OF TOTREQ AND TRUGLN
            ELSE CLEAR TRUSER
            ENDIF
            COMPUTE DEVICE UTILIZATION/THRUPUT, HSTARY(DEVDAT(CNT,5)+3), AS
             100 * TOTREQ * TRUSER / ELPTIM
          ELSE CLEAR HSTARY(DEVDAT(CNT,5)+3)
          ENDIF
        ENDIF
      ENDDO
      RETURN
C
C
C -----------------------------------------------------------------------
C  CODE
C -----------------------------------------------------------------------
      SUBROUTINE DMPR3
C
C     **LOCAL DECLARATIONS**
      INTEGER CNT,I
      REAL    TMOF,TMON,DSKTRN,TOTREQ,DEVTIM,TRUGLN,TRUSER
C     **GLOBAL DECLARATIONS**
      INTEGER   SAVDAT,PARTYP,BLKDAT,INTVAL,CPUCNT,PROCNM(4),TOTMEM
      INTEGER   TIMEON,TIMEOF,TIPCNT,REXMEM,EXCMEM,COMMEM,TIPMEM,RELMEM
      INTEGER   NUMDEV,DEMMEM,BATMEM,SWPCNT,BLDATE,PARMS(15),CDBMAX
      INTEGER   NUMCPU,DSKCNT,IN,IN1,IN2,IN3
      REAL      FEPFUJ,ELPTIM,SYSIDL,TIPPRG,DEVDAT(99,10)
      REAL      RTMPRG,DMDPRG,BATPRG,PROIDL,HSTARY(102)
      CHARACTER DEVDEF(99,4)*6,NEXTDY*1,EXLEVL*12,ENDFIL*1
      COMMON    FEPFUJ,PARMS,DEVDEF,DEVDAT,NUMDEV,SAVDAT,CPUCNT,ENDFIL
      COMMON    PARTYP,BLKDAT,INTVAL,NEXTDY,ELPTIM,PROCNM,TOTMEM,DSKCNT
      COMMON    NUMCPU,EXLEVL,TIMECN,TIMEOF,TIPCNT,SYSIDL,REXMEM,EXCMEM
      COMMON    COMMEM,TIPMEM,RELMEM,DEMMEM,BATMEM,SWPCNT,TIPPRG,RTMPRG
      COMMON   DMDPRG,BATPRG,BLDATE,PROIDL,HSTARY,IN,IN1,IN2,IN3,CDBMAX
      COMMON    DMDRST
C
      DO 490 I=1,102
         HSTARY(I) = -1.0
  490 CONTINUE
      TMON = (1.0*TIMEON) / 3600
      TMOF = (1.0*TIMEOF) / 3600
      HSTARY(1) = TMON - (IFIX(TMON/24.0) * 24.0)
      HSTARY(2) = TMOF - (IFIX(TMOF/24.0) * 24.0)
      HSTARY(3) = (SAVDAT * 0.01) + (IFIX(TMON / 24.0) * 0.01) + 0.005
      IF (PARMS(1).NE.0) THEN
         HSTARY(PARMS(1)+3) = TIPCNT / ELPTIM
      ENDIF
      IF (PARMS(2).NE.0) THEN
         HSTARY(PARMS(2)+3) = DMDPRG
      ENDIF
      IF (PARMS(3).NE.0) THEN
         HSTARY(PARMS(3)+3) = BATPRG
      ENDIF
      IF (PARMS(4).NE.0) THEN
         HSTARY(PARMS(4)+3) = RTMPRG
      ENDIF
      IF (PARMS(5).NE.0) THEN
```

```
                IF (TIPCNT.NE.0) THEN
                   HSTARY(PARMS(3)+3) = TIPPRC * ELPTIM / TIPCNT
                ENDIF
             ENDIF
             IF (PARMS(4).NE.0) THEN
                HSTARY(PARMS(4)+3) = SWPCNT
             ENDIF
             IF (PARMS(7).NE.0) THEN
                HSTARY(PARMS(7)+3) = 100 * (1-((SYSIDL+PROIDL) / CPUCNT)
     &       / ELPTIM)
             ENDIF
             IF (PARMS(8).NE.0) THEN
                HSTARY(PARMS(8)+3) = 100*(REXMEM+EXCMEM+CONMEM+TIPMEM+RELMEM+
     &       DEFMEM+SWTMEM)/TOTMEM
             ENDIF
             IF (PARMS(9).NE.0) THEN
             HSTARY(PARMS(9)+3) = SWPCNT / ELPTIM
             ENDIF
             IF (PARMS(10).NE.0) THEN
                DSKTRN = 0.0
                DSKCNT = 0
                DO 500 CNT=1,NUMDEV
                   IF ((DEVDEF(CNT,4).EQ.'DSKUL')
     &             .AND.(DEVDAT(CNT,6).EQ.0)) THEN
                      DSKTRN = DSKTRN + DEVDAT(CNT,12)
                      DSKCNT = DSKCNT + 1
                   ENDIF
500             CONTINUE
                HSTARY(PARMS(10)+3) = DSKTRN * 0.5 * 100 / ELPTIM
             ENDIF
             DO 510 CNT=1,NUMDEV
                IF ((DEVDEF(CNT,4).EQ.'CTVWL')
     &          .OR.(DEVDEF(CNT,4).EQ.'DEVWL')) THEN
                   IF (DEVDAT(CNT,6).EQ.0) THEN
                      HSTARY(DEVDAT(CNT,5)+3)=
     &                (DEVDAT(CNT,7)+DEVDAT(CNT,8))/ELPTIM
                   ELSE
                      HSTARY(DEVDAT(CNT,5)+3) = 0.0
                   ENDIF
                ENDIF
                IF (DEVDEF(CNT,4).EQ.'FEPWL') THEN
                   IF (DEVDAT(CNT,6).EQ.0) THEN
                      HSTARY(DEVDAT(CNT,5)+3)=((DEVDAT(CNT,7)+DEVDAT(CNT,8))
     &                * FEPFUD) / ELPTIM
                   ELSE
                      HSTARY(DEVDAT(CNT,5)+3) = 0.0
                   ENDIF
                ENDIF
                IF (DEVDEF(CNT,4).EQ.'DSKUL') THEN
                   IF (DEVDAT(CNT,6).EQ.0) THEN
                      TOTREQ = DEVDAT(CNT,7) + DEVDAT(CNT,8)
                      DEVTIM = DEVDAT(CNT,11) + DEVDAT(CNT,12)
                      IF ((TOTREQ.NE.0.0).AND.(DEVDAT(CNT,10).NE.0)) THEN
                         TRUQLN = 1 + (DEVDAT(CNT,9) / DEVDAT(CNT,10) - 1) *
     &                   DEVDAT(CNT,13) / TOTREQ
                      ELSE
                         TRUQLN = 1.0
```

```
                        ENDIF
                        IF (TOTREQ.NE.0.0) THEN
                           TRUSER = DEVTIP / (TOTREQ * TRUCLK)
                        ELSE
                           TRUSER = 0.0
                        ENDIF
                        HSTARY(DEVDAT(CNT,5)+7) = 100. * (TOTREQ * TRUSER /
     *                   ELPTIM)
                     ELSE
                        HSTARY(DEVDAT(CNT,5)+3) = 0.0
                     ENDIF
                  ENDIF
  510   CONTINUE
        RETURN
        END
C
C
C
C
C
C-----------------------------------------------------------------------
C  SUBROUTINE DRPFR4  (DATA REDUCTION MODULE - FORTRAN REDUCTION 4)
C
C  PURPOSE:    THIS MODULE WILL DO SOME FINAL DATA VERIFICATION AND THEN
C              WRITE THE HSTARY RECORDS INTO SPHISTORY.
C
C  INVOCATION METHOD:  CALL PMS.DRPFR4
C
C  FILE/RECORD REFERENCES:
C   FILE NAME            USE                 DESCRIPTION
C   PMS*SPHISTORY         O            SIP HISTORY FILE HOLDING DEVICE DATA
C
C  INTERMEDIATE VARIABLES:
C    NAME                TYPE                 DESCRIPTION
C    CNT                 INT            COUNTER FOR LOOPS
C    IN2                 INT/COMMON     SPHISTORY FILE REFERENCE NUMBER
C    NUMDEV              INT/COMMON     NUMBER OF DEVICES SPECIFIED IN
C                                       PARAMADEF.
C    HSTARY              REAL/COMMON    ONE DIMENSIONAL ARRAY OF 102 ELEMENTS
C                                       HOLDING DATA FOR SPHISTORY. CREATION
C    IDATE               INT            DATE FORMATING VARIABLE
C    MONTH               INT            MONTH OF BLOCK DATE
C    DAY                 INT            DAY OF BLOCK DATE
C    CALNDR              INT            ONE DIMENSIONAL ARRAY OF 12 ELEMENTS
C                                       HOLDING THE NUMBER OF DAYS IN EACH OF
C                                       THE 12 MONTHS
C    YEAR                INT            LAST TWO DIGITS OF YEAR
C    LEAP                REAL           USED FOR LEAP YEAR-DETERMINATION
C    REM                 REAL           REMAINDER OF YEAR DIVIDED BY 4
C
C  UNIT FLOW
C-----------------------------------------------------------------------
C  ((HSTARY ARRAY HAS COLMAX+1 RECORDS.  FIRST 2 RECORDS ARE THE TMON,
C   TMPF, AND DATE RECORDS. THE OTHER COLMAX RECORDS ARE DATA COLLECTED))
C  DO FOR CNT=1 TO COLMAX+1
C      ((HSTARY ELEMENT WITH VALUE 99999.99 REPRESENTS IMPERFECT DATA))
C     IF HSTARY(CNT) GT 9.0E+0
```

```
C     THEN SET HSTARY(CNT) TO -1.0D TO REPRESENT MISSING DATA
C     ENDIF
C ENDDO
C  (((FLIT HSTARY(2), THE DATE IN THE FORM YYMM.DD, INTO 3 INTEGER
C    VARIABLES))
C SET IDATE TO THE INTEGER PART OF HSTARY(1)
C SET MONTH TO MONTH REPRESENTATION OF IDATE
C SET DAY TO DAY REPRESENTATION OF HSTARY(2)
C SET YEAR TO YEAR REPRESENTATION OF HSTARY(1)
C  (((IF YEAR IS DIVISIBLE BY 4, IT IS A LEAP YEAR)))
C SET LEAP TO LEAP / 4.0
C SET REMAINDER, REM, TO REMAINDER PART OF LEAP
C IF REMAINDER .NE. ZERO, LOOKING AT A LEAP YEAR,
C THEN RESET NUMBER OF DAYS OF FEB., CALNDR(2), TO 29
C ENDIF
C IF (MONTH LIES IN THE RANGE OF VALID MONTH NUMBERS 1 THROUGH 12)
C  AND (DAY IS LT OR EQ TO THE NUMBER OF DAYS IN MONTH, CALNDR(MONTH),
C    CORRECTED FOR EXTRA DAY IN FEBRUARY DURING LEAP YEARS)
C THEN WRITE TO SPHISTORY, RECORDS OF HSTARY(CNT), CNT=1 TO CDBMAX+2
C ENDIF
C RETURN
C
C-----------------------------------------------------------------------
C CODE
C-----------------------------------------------------------------------
      SUBROUTINE DPMFR4
C
C     **LOCAL DECLARATIONS**
      REAL      LEAP,REM
      INTEGER   CNT,IDATE,MONTH,DAY,YEAR
      INTEGER   CALNDR(12) /31,28,31,30,31,30,31,31,30,31,30,31/
C     **GLOBAL DECLARATIONS**
      INTEGER    SAVDAT,PARTYP,ELKDAT,INTVAL,CPUCNT,PROCNM(4),TOTMEM
      INTEGER    TIMEON,TIMEOF,TIPCNT,REXMEM,EXCMEM,COMMEM,TIPMEM,RELMEM
      INTEGER    NUMDEV,DEMMEM,BATMEM,SWPCNT,BLDATE,PARMS(15),CDBMAX
      INTEGER    NUMCPU,DSKCNT,IN,IN1,IN2,IN3
      REAL       FEPFUJ,ELPTIM,SYSIDL,TIPPRG,DEVDAT(99,16)
      REAL       RTMPRG,CMDPRC,BATPRG,PRGIDL,HSTARY(102)
      CHARACTER DEVDEF(99,4)*8,NEXTDY*1,EXLEVL*12,ENDFIL*1
      COMMON     FEPFUJ,PARMS,DEVDEF,DEVDAT,NUMDEV,SAVDAT,CPUCNT,ENDFIL
      COMMON     PARTYP,ELKDAT,INTVAL,NEXTDY,ELPTIM,PROCNM,TOTMEM,DSKCNT
      COMMON     NUMCPU,EXLEVL,TIMEON,TIMEOF,TIPCNT,SYSIDL,REXMEM,EXCMEM
      COMMON     COMMEM,TIPMEM,RELMEM,DEMMEM,BATMEM,SWPCNT,TIPPRG,RTMPRG
      COMMON    CMDPRC,BATPRG,BLDATE,PRGIDL,HSTARY,IN,IN1,IN2,IN3,CDBMAX
      COMMON    ENDRST
C
      DO 730 CNT=1,(CDBMAX+3)
         IF (HSTARY(CNT).GT.9000.0D) HSTARY(CNT) = -1.0D
  730 CONTINUE
      IDATE = IFIX(HSTARY(1))
      MONTH = MOD(IDATE,100)
      DAY   = IFIX((HSTARY(2)+0.005)*100.0) - (100*IDATE)
      YEAR  = IFIX(IDATE/100.)
      LEAP  = YEAR / 4.0
      REM   = LEAP - IFIX(LEAP)
      IF (REM.LT.0.001) CALNDR(2) = 29
      IF ((MONTH.GT.0).AND.(MONTH.LT.13)
```

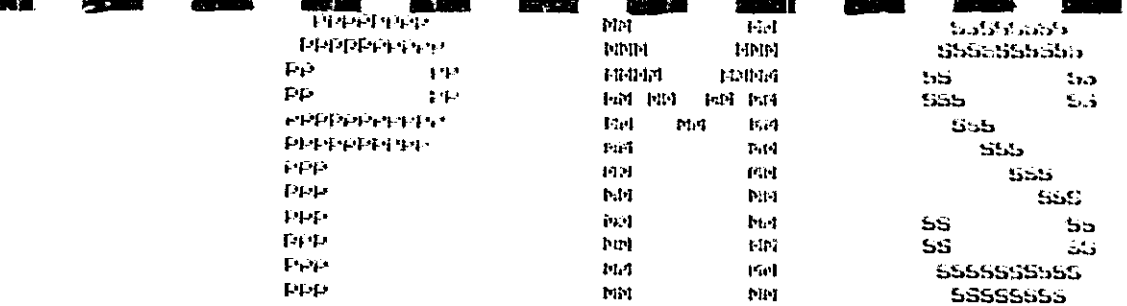
```
        $  .AND.(DAY).LE.CALNDR(MONTH))) THEN
             IF (((CDBMAX+3).GT.16) THEN
                WRITE(IN3,700) (HSTARY(CNT),CNT=1,16)
             ELSE
                WRITE(IN3,700) (HSTARY(CNT),CNT=1,CDBMAX+3)
             ENDIF
             IF (((CDBMAX+3).GT.32) THEN
                WRITE(IN3,700) (HSTARY(CNT),CNT=17,32)
             ELSE
                IF (((CDBMAX+3).GT.16) THEN
                   WRITE(IN3,700) (HSTARY(CNT),CNT=17,CDBMAX+3)
                ENDIF
             ENDIF
             IF (((CDBMAX+3).GT.48) THEN
                WRITE(IN3,700) (HSTARY(CNT),CNT=33,48)
             ELSE
                IF (((CDBMAX+3).GT.32) THEN
                   WRITE(IN3,700) (HSTARY(CNT),CNT=33,CDBMAX+3)
                ENDIF
             ENDIF
             IF (((CDBMAX+3).GT.64) THEN
                WRITE(IN3,700) (HSTARY(CNT),CNT=49,64)
             ELSE
                IF (((CDBMAX+3).GT.48) THEN
                   WRITE(IN3,700) (HSTARY(CNT),CNT=49,CDBMAX+3)
                ENDIF
             ENDIF
             IF (((CDBMAX+3).GT.80) THEN
                WRITE(IN3,700) (HSTARY(CNT),CNT=65,80)
             ELSE
                IF (((CDBMAX+3).GT.64) THEN
                   WRITE(IN3,700) (HSTARY(CNT),CNT=65,CDBMAX+3)
                ENDIF
             ENDIF
          ENDIF
   700    FORMAT(16(F7.4,1X))
          RETURN
          END
   C
   C
   C
   C
```

```
@PRT,S PFS.CAMFE1
```

APPENDIX C

SAMPLE REPORT

GENERATED BY PMS2



TRACKING AND DATA RELAY SATELLITE SYSTEM

PERFORMANCE MANAGEMENT SYSTEM

DISTRBUTION LIST:

MR. Isley/800.1
MR. Barsky/820
MR. Tagler/830
MR. Spintman/850
MR. Brumberg/870
MR. Lalos/820.1
MR. Goodson/820.1
MR. Parker/820.1
MR. Packard/823
MR. Butler/823
MR. Grunby/823
MS. Frazier/BEFC/TDRSS
MR. Goorevich/CSC
MR. Durham/CSC
DR. Holcomb/MITRE
DR. Kelly/Datametrics
DR. Cleaver/UL
DR. Shelton/UL

PERIOD: 08/06/84 TO 08/09/84

NETWORK CONTROL CENTER

MONTHLY REPORT

PMS OPERATOR:

RAMIN AHDUR

PMS DEVELOPER:

ELECTRICAL ENGINEERING DEPT.
UNIVERSITY OF LOUISVILLE
LOUISVILLE, KY 40292
(502)-588-6289

REPORT DATE: 10/23/84

TABLE OF CONTENTS AND LIST OF FIGURES

C.B

TABLE 3.1 - BUSIEST DAY SUMMARY : 08/07/84

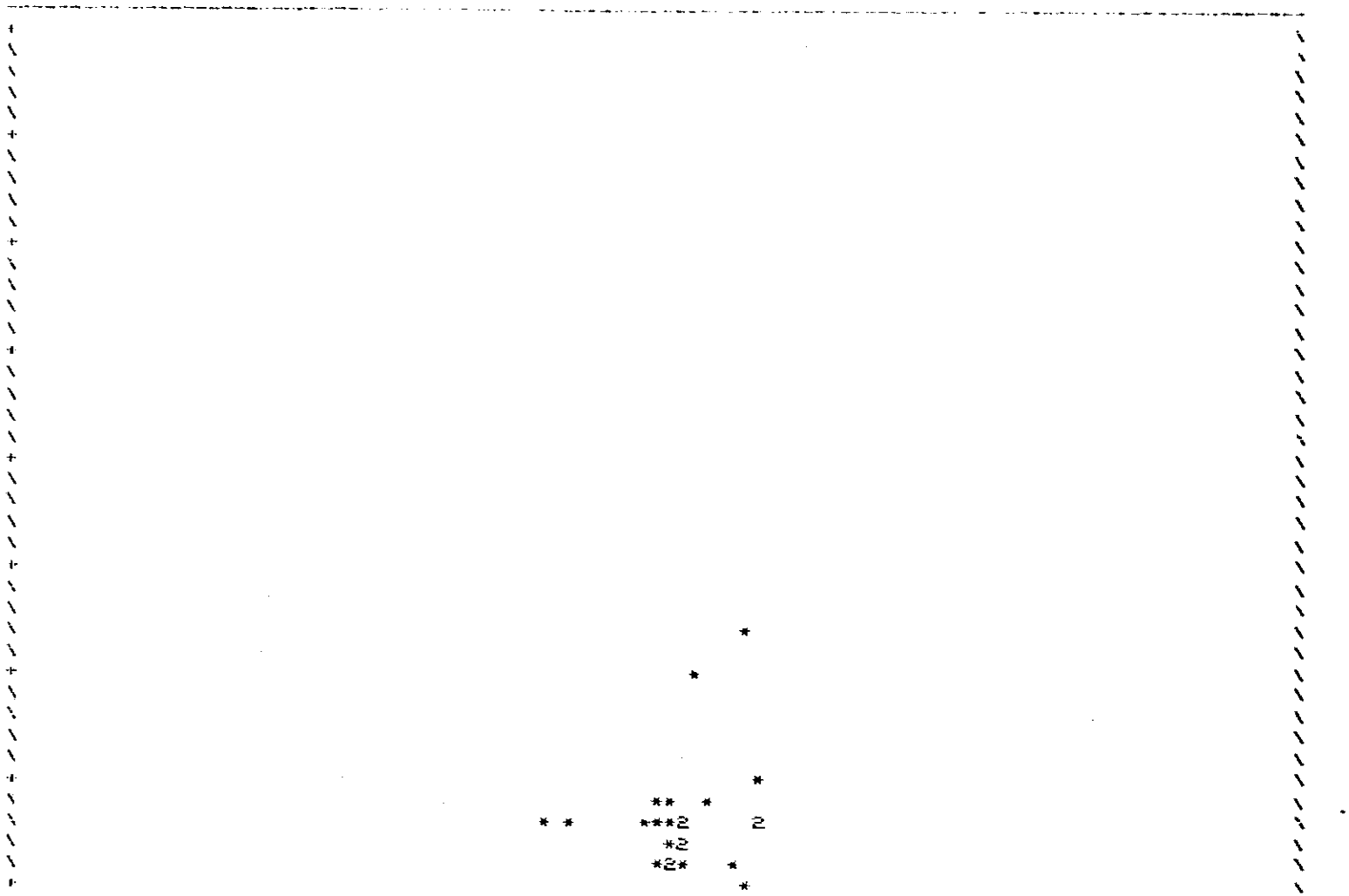
TIME ON (11)	TIMEOFF (12)	TIP THRUPUT (2)	TIP RESPTM. (3)	CPU UTIL. (4)	MEM UTIL. (5)	HIGHEST DSKUTIL (6)	AVERAGE DSKUTIL (7)	HIGHEST FEPUTIL (8)	AVERAGE FEPUTIL (9)	DTV THRUPUT (10)
23.63	.02	.59	28.81	6.50	54.00	7.35	1.07	.25	.14	1.60
.03	.53	.50	33.62	37.04	57.00	17.07	2.88	.23	.11	1.04
.13	.63	.22	64.06	34.00	56.00	16.32	2.75	.22	.09	.84
.63	1.13	.22	64.90	5.08	51.00	1.78	.36	.22	.09	.85
1.13	1.63	.24	59.41	4.22	51.00	1.31	.30	.22	.09	.89
1.63	2.13	.23	60.29	4.46	51.00	1.34	.37	.22	.09	.89
2.13	2.63	.22	64.40	3.94	51.00	1.31	.27	.22	.09	.87
2.63	3.13	.29	49.15	4.83	50.00	1.72	.50	.22	.09	.99
3.13	3.63	.24	59.38	4.18	50.00	1.37	.32	.22	.09	.87
3.63	4.13	.26	53.13	4.48	50.00	1.39	.39	.21	.08	.94
4.13	4.63	.40	35.00	5.57	50.00	3.17	.73	.23	.09	1.13
4.63	5.13	.39	35.80	5.77	50.00	2.77	.80	.21	.08	1.14
5.13	5.63	.50	28.08	6.31	50.00	4.71	.90	.23	.10	1.52
5.63	6.13	.94	15.02	9.16	50.00	5.68	1.17	.26	.14	2.13
6.13	6.63	2.26	6.66	18.21	49.00	11.63	2.11	.37	.18	4.54
6.63	7.13	1.72	8.74	14.19	50.00	5.11	1.14	.32	.17	3.84
7.13	7.63	1.37	11.41	12.49	51.00	2.07	.63	.32	.17	2.87
7.63	8.13	1.96	7.98	17.41	52.00	26.03	2.89	.36	.18	4.16
8.13	8.63	2.16	7.33	15.81	52.00	3.56	.67	.35	.18	4.68
8.63	9.13	2.42	6.59	17.71	52.00	7.71	1.40	.35	.18	5.30
9.13	9.63	2.70	5.57	20.39	51.00	14.27	2.22	.36	.18	5.85
9.63	10.13	2.24	6.48	19.28	50.00	25.10	3.09	.35	.18	4.78
10.13	10.63	1.49	10.09	13.88	51.00	4.93	.97	.35	.18	3.28
10.63	11.13	1.99	7.33	17.60	50.00	6.86	1.26	.48	.20	4.05
11.13	11.63	1.79	8.36	16.83	51.00	3.19	.80	.49	.21	3.78
11.63	12.13	1.71	9.38	14.52	51.00	3.03	.79	.44	.20	3.53
12.13	12.63	2.05	8.63	19.11	54.00	3.70	1.16	.49	.22	4.40
12.63	13.13	1.37	13.65	13.08	56.00	3.72	1.04	.41	.18	2.65
13.13	13.63	.55	34.50	5.67	56.00	2.63	.68	.22	.13	1.17
13.63	14.13	.55	34.73	5.61	56.00	3.64	.72	.22	.13	1.11
14.13	14.63	.57	33.28	6.34	56.00	2.82	.87	.21	.12	1.13
14.63	15.13	.63	30.40	6.18	56.00	3.20	.85	.21	.08	1.26
15.13	15.63	.58	32.68	5.45	56.00	2.47	.61	.21	.09	1.14
15.63	16.13	.60	31.70	7.35	57.00	4.07	.94	.22	.09	1.19
16.13	16.63	.62	30.53	21.31	58.00	8.59	1.67	.21	.08	1.25
16.63	17.13	.64	29.81	16.87	58.00	7.69	1.80	.22	.11	1.30
17.13	17.63	.65	29.21	9.32	57.00	7.76	1.58	.26	.14	1.21
17.63	18.13	.52	36.54	11.30	57.00	3.20	.90	.23	.13	1.03
18.13	18.63	.58	32.62	6.83	56.00	3.20	.82	.22	.13	1.16
18.63	19.13	.45	41.98	4.98	57.00	1.93	.42	.22	.13	.98
19.13	19.63	.42	45.67	4.54	57.00	1.69	.30	.21	.13	.85
19.63	20.13	.55	33.68	18.12	58.00	9.45	1.18	.22	.13	.67
20.13	20.63	.48	37.61	5.61	56.00	2.83	.56	.22	.13	.08
20.63	21.13	.46	39.05	5.06	56.00	1.95	.45	.22	.13	.01
21.13	21.63	.51	35.43	5.03	55.00	1.94	.44	.22	.13	.63
21.63	22.13	.42	40.56	4.54	54.00	1.89	.34	.22	.13	.90
22.13	22.63	.44	39.02	4.50	54.00	1.90	.31	.22	.13	.90
22.63	23.13	.51	32.99	5.08	54.00	2.03	.49	.22	.13	1.00
23.13	23.63	.54	31.21	5.54	54.00	2.57	.62	.23	.13	1.07

******* DENOTES DATA NOT AVAILABLE TO PMS 2...12: SEE SECTION 5 FOR EXPLANATION

DATA REDUCTION REPORT

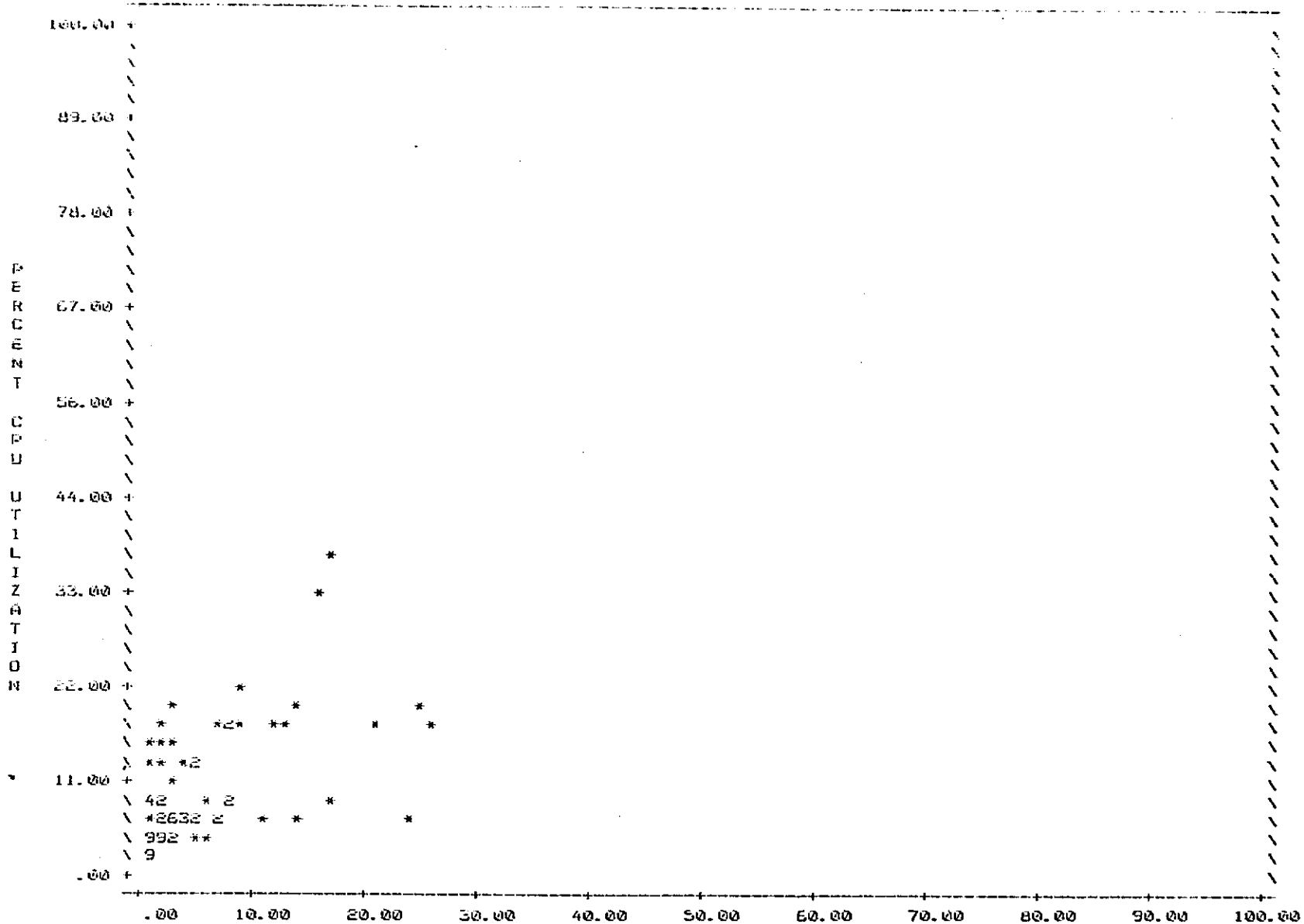
DAYS OF MONTH (1)	TIP THRUPUT (2)	TIP RESPTM. (3)	CPU UTIL. (4)	MEM. UTIL. (5)	HIGHEST DSKUTIL (6)	AVERAGE DSKUTIL (7)	HIGHEST FEPUTIL (8)	AVERAGE FEPUTIL (9)	DTV THRUPUT (10)
8408.08#	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00
8408.07	.89	30.67*	10.85*	53.39*	5.22	1.01	.27	.13	1.89*
8408.08	.44	71.84*	5.57*	44.29*	3.47	.61	.25	.11	1.29*
8408.09#	.90	6.55*	17.35*	41.00*	20.72	2.22	.19	.12	.71*

# DENOTES ENTRY WITH LESS THAN 40 SIP BLOCKS OF DATA
*DENOTES THRESHOLD EXCEEDED ENTRIES
-1.0 DENOTES DAYS OR DATA NOT AVAILABLE TO PMS
1...10: SEE SECTION 5 FOR EXPLANATION OF ENTRIES



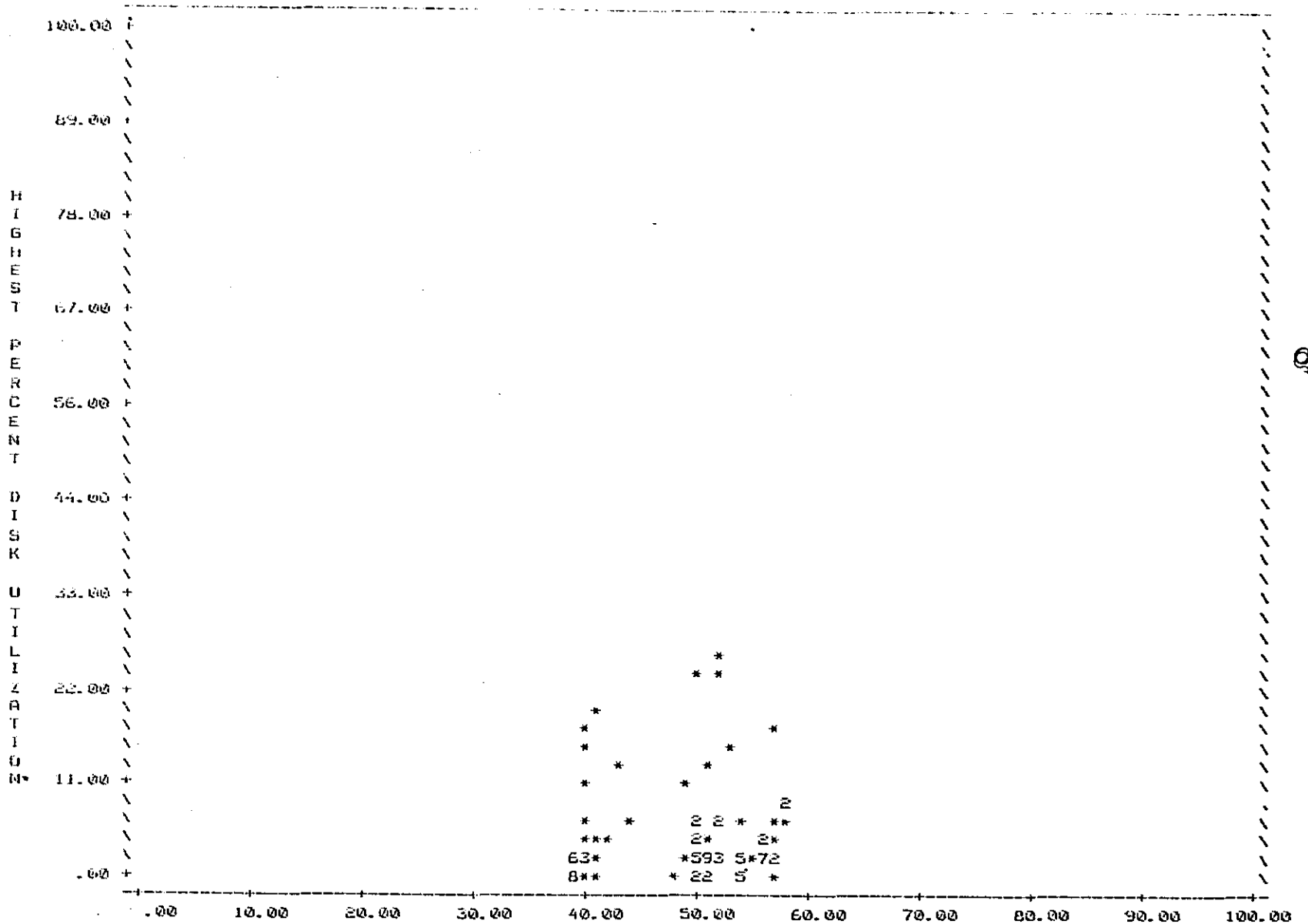
YMIN= 2.17 YMAX= 37.04 YMEAN= 8.39
XMIN= 39.00 XMAX= 58.00 XMEAN= 48.90

Figure 3.1 - CPU UTILIZATION vs MEMORY UTILIZATION



YMIN= 2.17 YMAX= 37.04 YMEAN= 8.39
XMIN= .84 XMAX= 26.03 XMEAN= 4.54

Figure 3.2 - CPU UTILIZATION vs HIGHEST DISK UTILIZATION



YMIN= .84 YMAX= 26.03 YMEAN= 4.54
XMIN= 39.00 XMAX= 58.00 XMEAN= 48.90

Figure 3.3 - HIGHEST DISK UTILIZATION vs MEMORY UTILIZATION

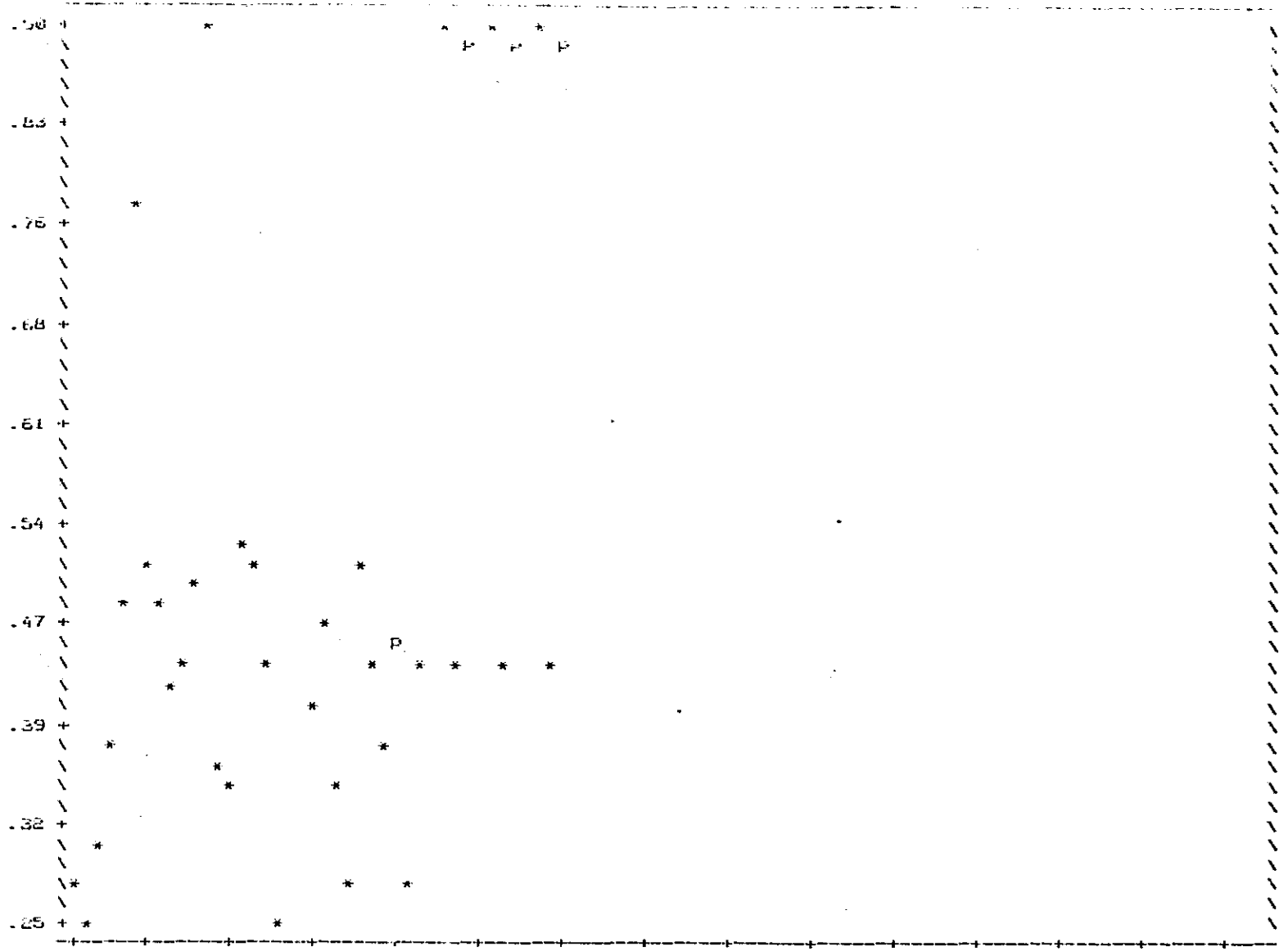
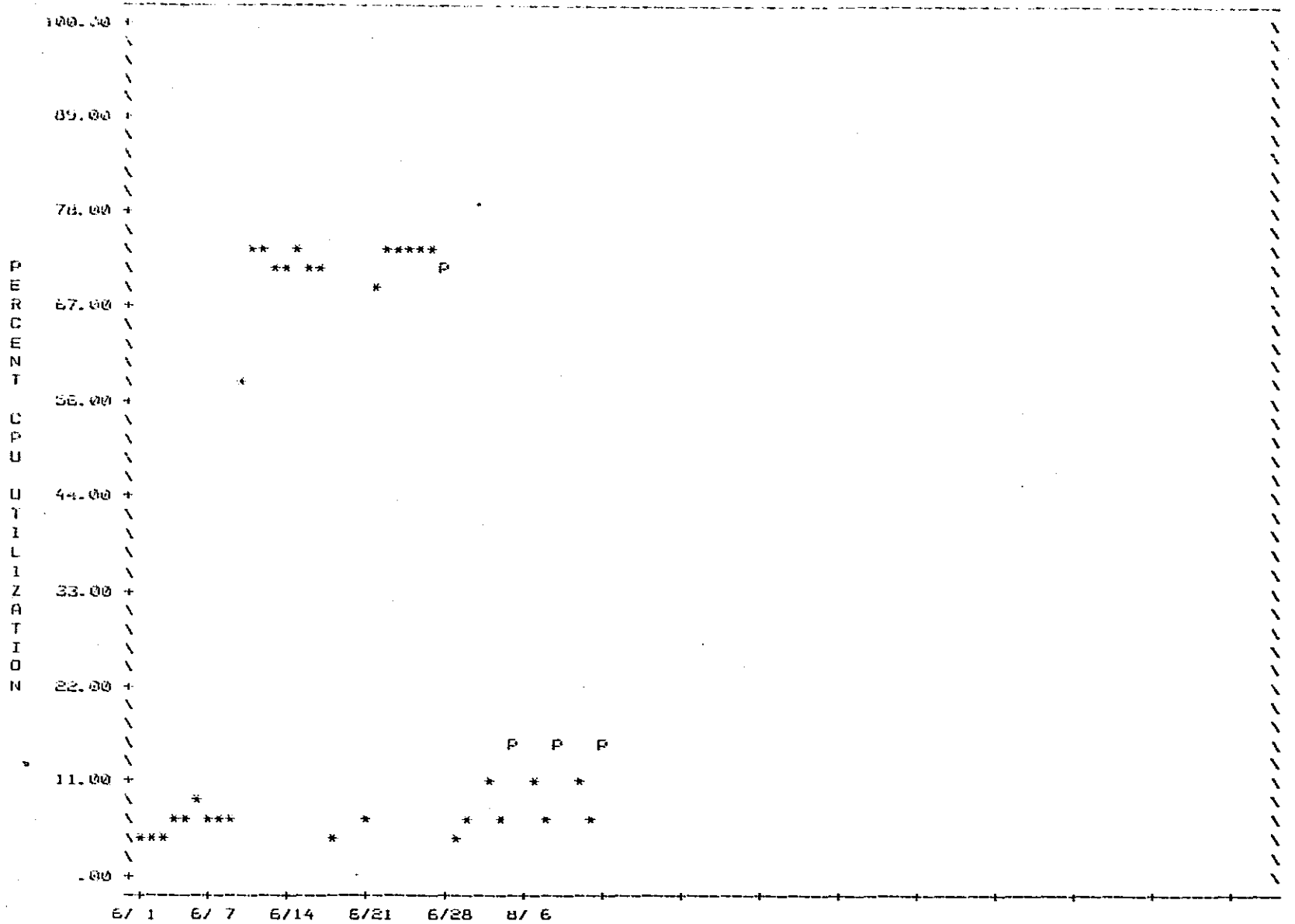
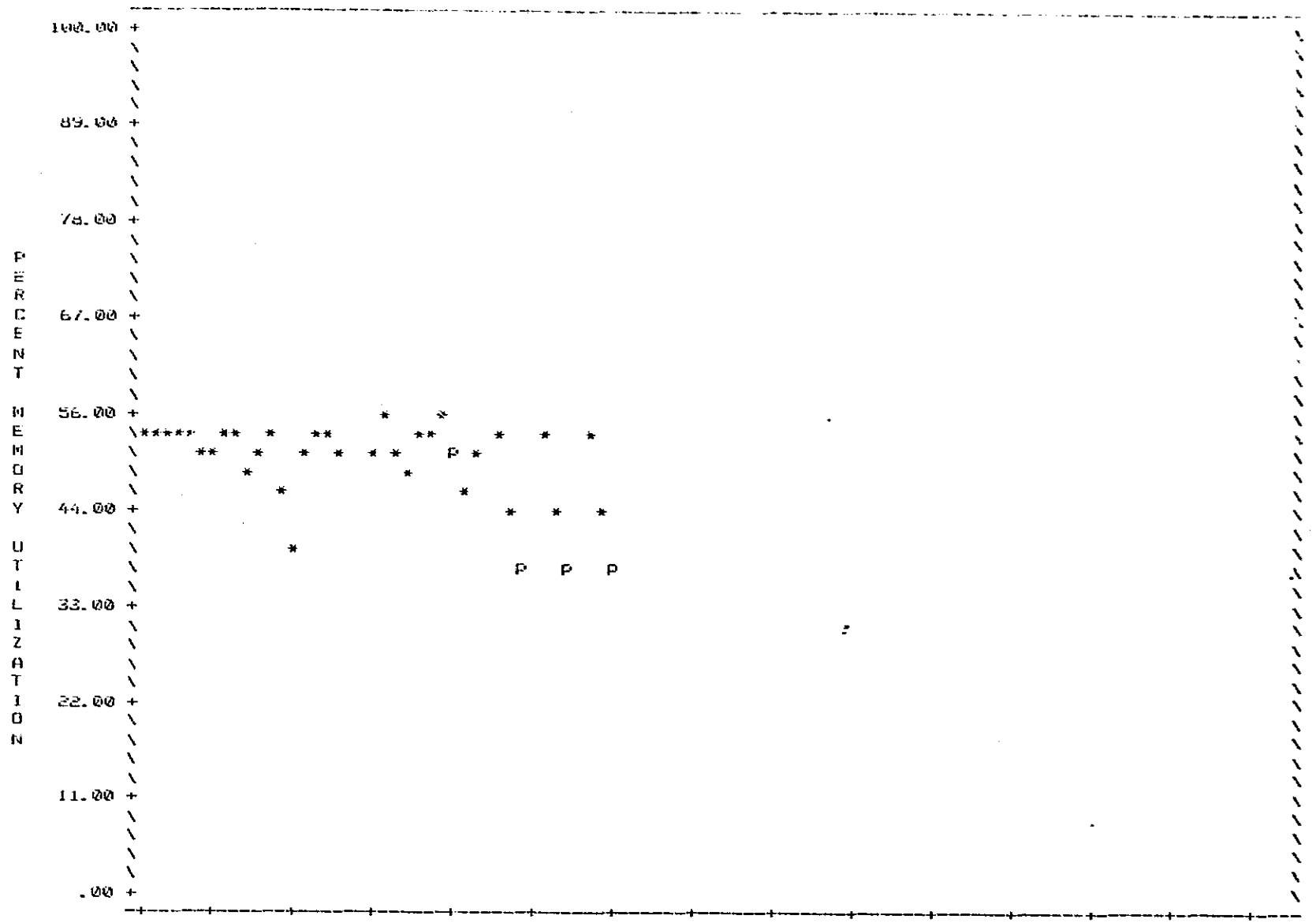


Figure 3.4 - TIP TRANSACTIONS PER SECOND vs DAY OF MONTH



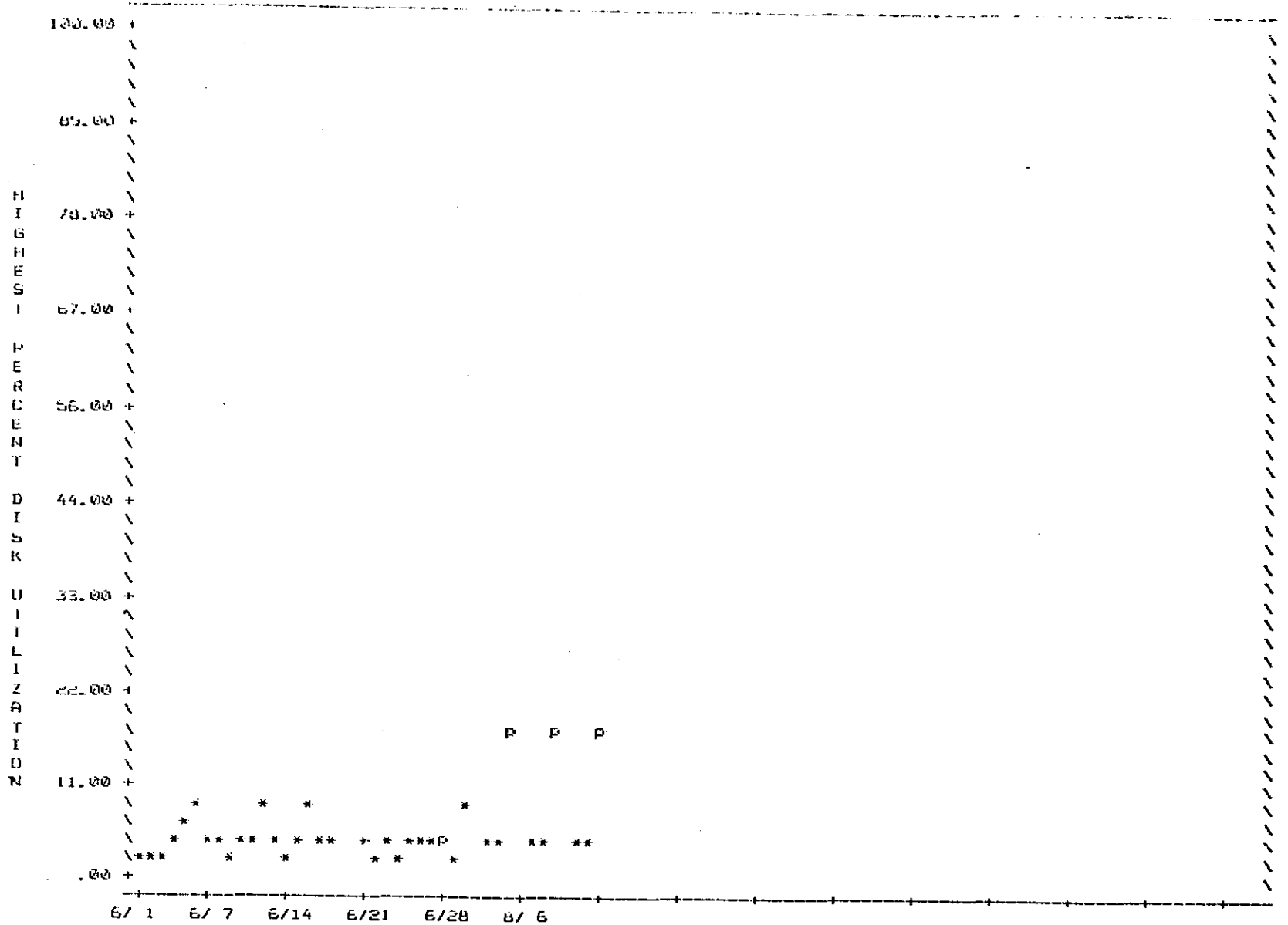
YMIN= 4.86 YMAX= 73.21 YMEAN= 29.82

Figure 3.5 - CPU UTILIZATION vs DAY OF MONTH



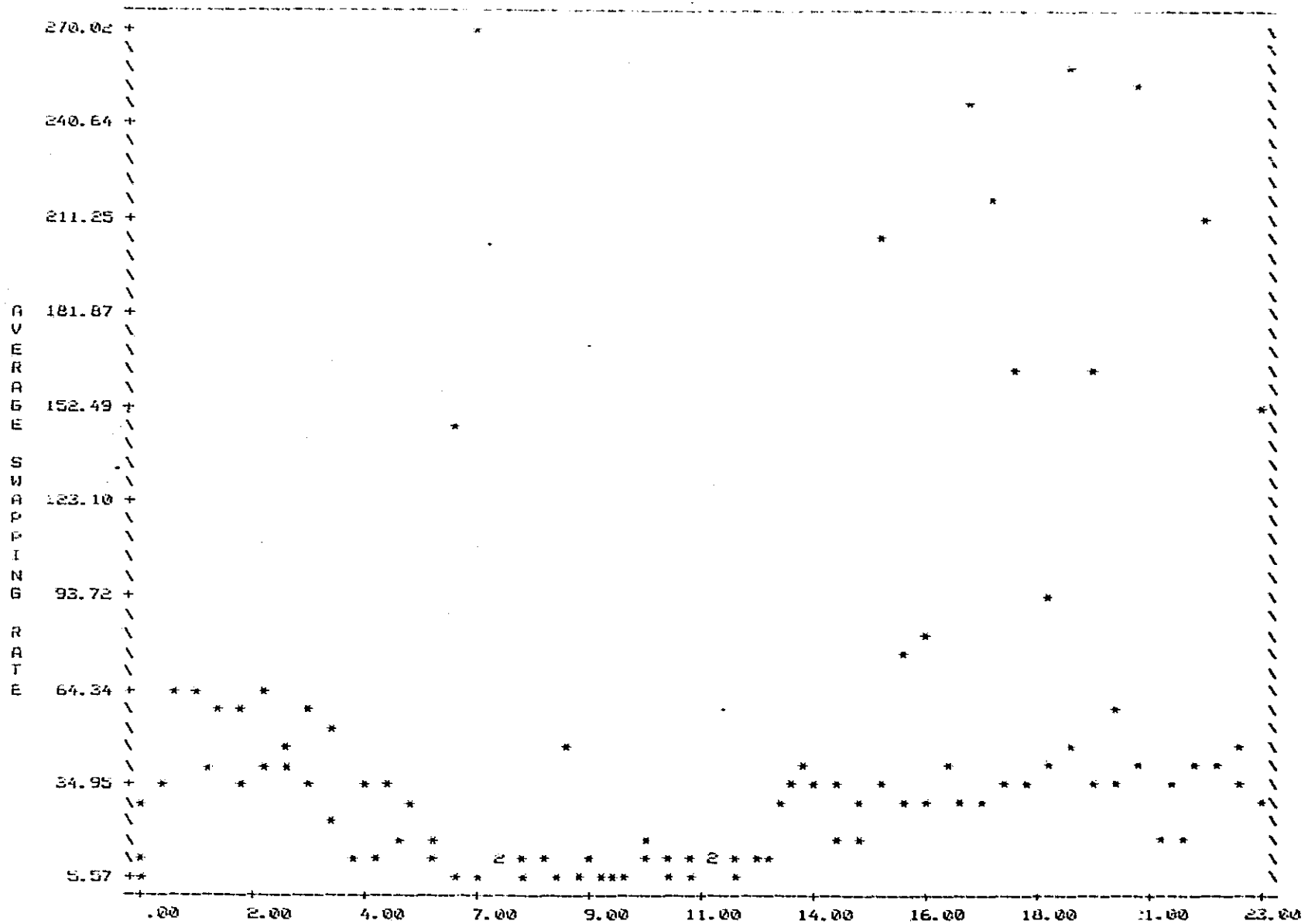
YMIN= 40.90 YMAX= 54.71 YMEAN= 44.33

Figure 3.6 - MEMORY UTILIZATION vs DAY OF MONTH



YMIN= 1.50 YMAX= 20.72 YMEAN= 5.03

Figure 3.7 - HIGHEST DISK UTILIZATION vs DAY OF MONTH



YMIN= 5.57 YMAX= 270.02 YMEAN= 50.14

Figure 4.5 - AVERAGE SWAPPING RATE vs TIME OF DAY

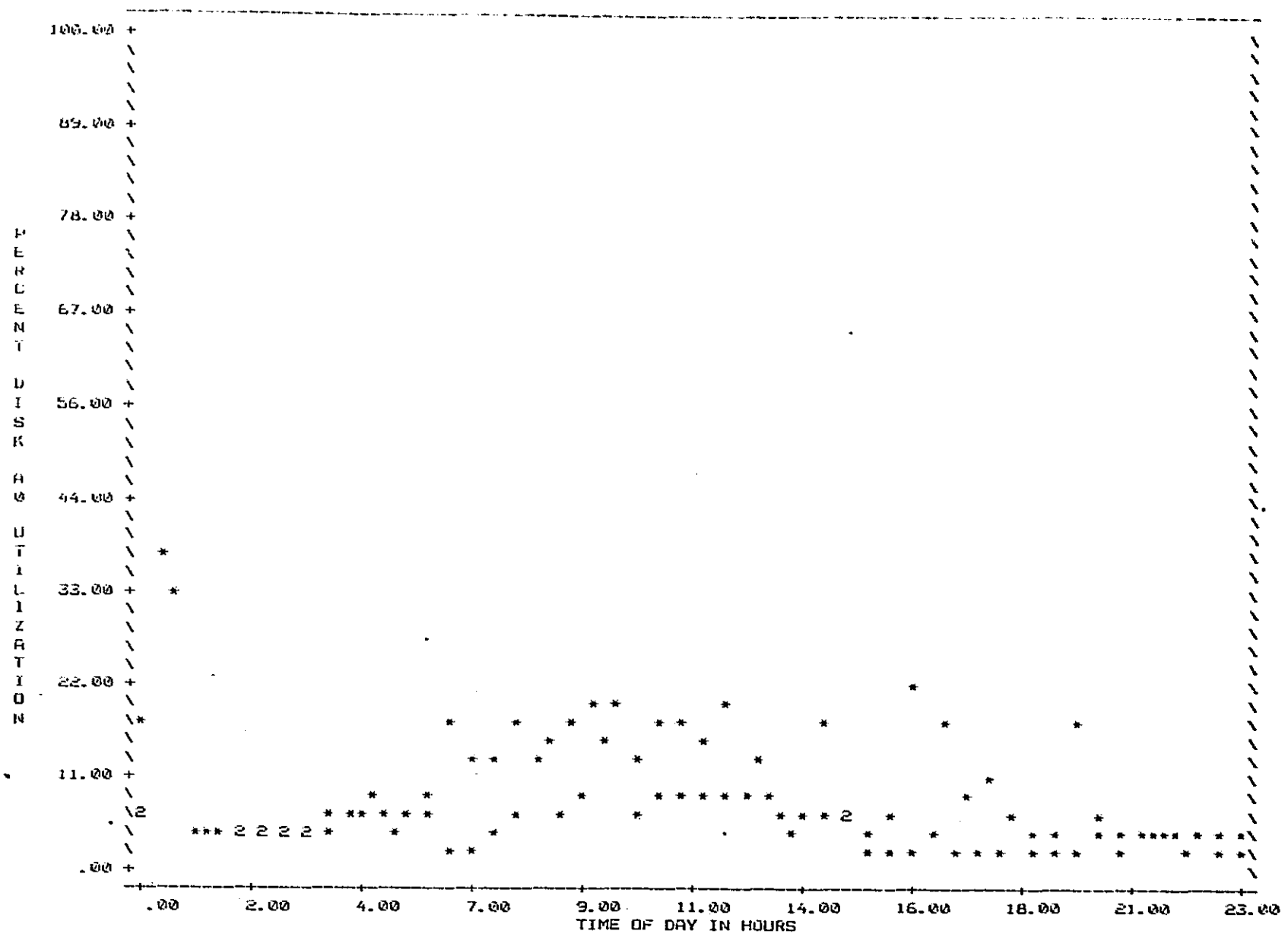
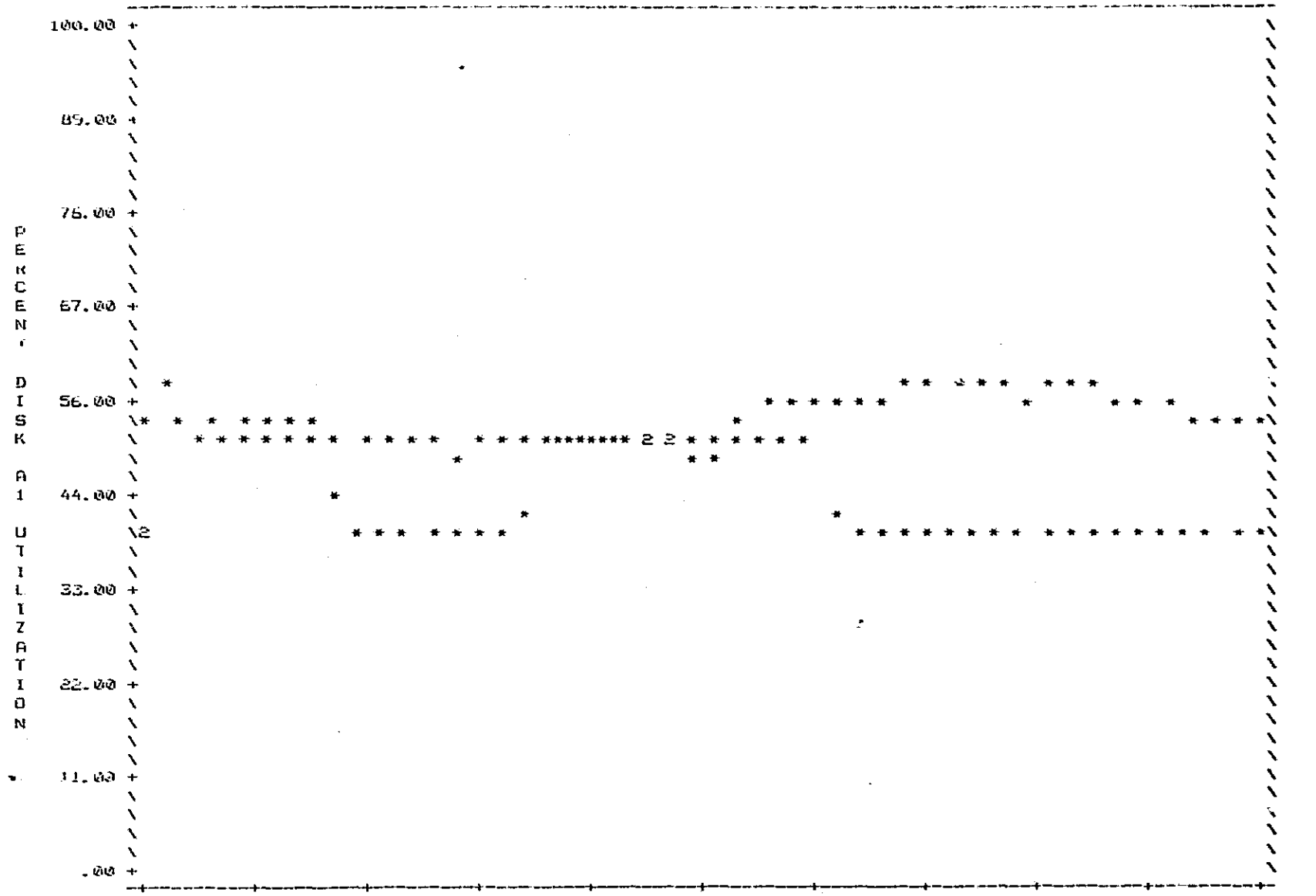


Figure 4.7 – DISK A0 UTILIZATION vs TIME OF DAY



YMIN= 39.00 YMAX= 58.00 YMEAN= 48.90

Figure 4.8 - DISK A1 UTILIZATION vs TIME OF DAY

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APPENDIX D

REFERENCES

AND

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