

TO: MTB Distribution  
FROM: Roger A. Roach  
DATE: October 12, 1974  
SUBJECT: Revision of Multics Performance Tests

### I. Description of First Version

The first version of the performance test (also called the acceptance test) was written by Jayne Keller based on a similar program by Douglas Hunt. The purpose of this test was to satisfy the contractual requirements for the acceptance of the 6180 Multics. This test consisted of one script which was read through a special DIM by multiple absentee processes. This DIM is initialized by a call to `acceptance_test$init` in the script. This call also signaled the master process (one which submitted the absentee requests) and then went blocked. When the master process received a signal from each process it had started, it reset some system meters (`tftm`, `pmtm`, `fsm` and `dvm`) and then signaled the processes to start. In each process, the DIM then read a line from the script inserting a random delay (between two figures as specified by the controlling process) between each line read. This delay was intended to simulate actual think times to keep the various processes from getting in sync. (This did not perform as well as intended, see problem #1 below.) As each process finished the script, it signaled the master process that it was done, storing its total usage figures in a data array. When all processes completed, the master process printed out the system meters as well as total usage figures.

The script itself consisted of two parts. The first part was a functional test of almost all of the commands in the MPM (revision 12). The second part was a script written in an attempt to simulate actual usage of the editors, compilers, binder and debugger. The reason why a script was used instead of a random selection of commands from a table was that it was feared that unless the test was able to run for a very long period of time, the variations in the actual commands executed would be larger than the difference we were trying to measure. (Just one extra large compilation could cause the meters to vary as much as 2%.)

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Initial settings had twenty users logged in with "think" times of between two and fifteen seconds. Even with these settings, the script took over six hours to run on the 645 (as compared to 90 minutes on the 6180). Since then, this script has been used to measure performance changes in systems installed on the 6180. We have identified the following problems with this script:

1. The script did get in sync and most of the compilations were run at the same time in each process. It is felt that this problem could be greatly reduced if the processes were given interactive credit when they "wake up". Also having more than one script would help eliminate any synchronization. (It could be totally eliminated by having a unique script per process.)
2. Lack of heavy paging activity kept the script from accurately simulating actual usage. (The script only read/wrote about 5000 pages to and from the disks during the hour and a half running time.)
3. The small number of users (20) also kept the system from approaching the normal load in the scheduling area. It was recognized early that a larger number of users would be desirable, but the number could not be increased without greatly increasing the time spent on the 645 or decreasing the overall load of the test on a per process basis.
4. The tests started to show relatively large amounts of zero idle (13%) and thus changes in performance were harder to detect. (A 10% change in performance would only show as a 8% or 9% change depending on where it was located.)
5. Lack of a large working set kept the script from testing the linker under realistic conditions. This problem is hard to solve using only code installed in the system libraries. Under actual usage, the users are using their own programs and subsystems to create a much large combined working set than would be possible by using only the system commands. However, since the tests need code that will continue to work from test to test, it can not incorporate commands not installed in the system libraries.
6. Since Backup is not running during the tests, both the tape system and directory control are not measured. The reason Backup is not run is that the tests are run on the standard hierarchy and there is no "control" hierarchy that could be used to create a consistent test.

7. Since the tests are all run under absentee, the typewriter DIM is not used and thus the script can not detect changes in its performance. A way of solving this problem is to have a driving computer (perhaps the 355) feeding the input lines through the typewriter channels.

## II. Description of Second Version

To help solve problem #1 above, five scripts were created out of the one script. The first portion of the old script was discarded as it was of doubtful usefulness and was difficult to maintain with changes being made to the system. Four copies of the second portion were made, each slightly different (a line was inserted at the front of each script invoking a different compiler to keep the script from getting in sync, but still keeping each script about equal in overall length). A fifth script was created with just compilations and flushes to create a heavy load on the system, especially in the paging area. This script was tuned to have it complete within fifteen minutes of the other scripts to avoid the zero idle. By reducing the size of the script (by removing the function test), the number of scripts run at a time was able to be increased to forty. This coupled with the setting of tmax at one second has helped increase the paging and scheduling load so that it more closely approximates actual usage. Problems five thru seven were deemed too difficult to solve at this time. Therefore, an attempt will be made to determine the effect of changes in the dumper or tty DIM and to change the goal by an appropriate amount.

## III. Calibrating the New Tests

Exact calibration of the new test (script2) with the old test (script1) is not possible for the older systems (especially 23.3) as changes had been made in the online system which depended upon changes in the hardware system and the test uses the current hierarchy. Therefore sets of tests were made on systems 23.12 and beyond to attempt to obtain a ratio that could be used for extrapolating back to 23.3 to get revised performance goals. The goal as outlined in MTB-087 was to get a 50% improvement on system 23.3. Although this improvement is to be measured in elapsed time, it was felt useful to present the goal in terms of virtual CPU time, total CPU time, page faults and memory units. (A 50% improvement in any of these areas would be highly significant.) In order to obtain these ratios, the tests were run with identical systems and identical configurations on at least seven systems. The ratios for each run were

calculated and tabulated (see Appendix A). The highest and lowest values were discarded and then an average taken of the remainder. The results are presented below. For each of the five areas of concern, the following numbers are given: 1) the 23.3 values using the old script, 2) the ratio of the old script values to the new script values and 3) the new goal (is  $.5 * 23.3$  values / ratio).

|               | 23.3 values | ratio | goal     |
|---------------|-------------|-------|----------|
| Elapsed Time: | 104.5 min   | .881  | 59.3 min |
| Virtual CPU:  | 3844 sec    | .912  | 2107 sec |
| Total CPU:    | 5495 sec    | .813  | 3379 sec |
| Page Faults:  | 531088      | .805  | 329868   |
| Memory Units: | 43282       | .950  | 22780    |

N.B. The 23.3 run was made on one disk channel and with directory write-through turned on. Most runs on newer systems are run on two disk channels and without write-through.

#### IV. Current Status

The following table shows the current status of meeting our performance goals as of system 24.0a:

|               | 23.3 *    | goal     | 24.0a    | % to goal |
|---------------|-----------|----------|----------|-----------|
| Elapsed Time: | 118.6 min | 59.3 min | 93.1 min | 43.0%     |
| Virtual CPU:  | 4215 sec  | 2107 sec | 3369 sec | 40.2%     |
| Total CPU:    | 6759 sec  | 3379 sec | 5148 sec | 47.7%     |
| Page Faults:  | 659737    | 329868   | 522747   | 41.5%     |
| Memory Units: | 45560     | 22780    | 37257    | 36.4%     |

\* adjusted (23.3 old script value / ratio)

## Appendix A

Table of Ratios (script1/script2)

| system              | dates                   | Elapsed<br>Time | Virtual<br>CPU | Total<br>CPU | Page<br>Faults | Memory<br>Units |
|---------------------|-------------------------|-----------------|----------------|--------------|----------------|-----------------|
| 23.12a              | 07/03<br>-----<br>07/01 | .885            | .940*          | .834*        | .784           | .948            |
| 23.13a              | 07/22<br>-----<br>07/14 | .896            | .904           | .813         | .817           | .950            |
| 23.13a              | 07/25<br>-----<br>07/27 | .864*           | .900*          | .795         | .777           | .935            |
| 23.13a              | 07/29<br>-----<br>07/29 | .883            | .902           | .791*        | .771*          | .927*           |
| 23.14c              | 08/07<br>-----<br>08/03 | .872            | .917           | .819         | .834*          | .972*           |
| 23.14c              | 08/07<br>-----<br>08/08 | .871            | .918           | .819         | .832           | .970            |
| 23.15a              | 08/24<br>-----<br>08/25 | .921*           | .921           | .818         | .814           | .948            |
| Average ratio:      |                         | .881            | .912           | .813         | .805           | .950            |
| Standard Deviation: |                         | .010            | .009           | .010         | .023           | .013            |

\* ratio discarded as being on low or high end.

## Appendix B

## Metering Results

The following pages contain the summaries of the metering runs. Future pages will be issued as MTB's for approximately every eight runs or whenever a significant change occurs.

# Metering Comparisons for 21.3a, 21.3c, 21.4a, 21.8a, 22.0a

| System:               | 21.3a    | 21.3c    | 21.4a    | 21.8a    | 21.8a    | 22.0a    | 22.0a    |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|
| Date:                 | 11/18/73 | 11/24/73 | 12/01/73 | 01/14/74 | 01/14/74 | 01/21/74 | 01/21/74 |
| Write-through status: | none     | dirs     | none     | dirs     | none     | none     | dirs     |
| Device Checking:      | none     | 1        | 1        | 1        | 1        | 1        | 1        |
| Reused Address Check: | OFF      | OFF      | OFF      | OFF      | OFF      | OFF      | OFF      |
| TTY tracing:          | 2        | OFF      | OFF      | OFF      | OFF      | OFF      | OFF      |
| Paging Device Size:   | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    |
| Elapsed Time:         | 91.6 min | 96.1 min | 92.6 min | 93.0 min | 91.7 min | 93.3 min | 94.3 min |
| Costs (shift 1):      | \$733.14 | \$784.72 | \$770.05 | \$764.71 | \$750.63 | \$762.83 | \$779.41 |
| Costs (shift 2):      | \$670.54 | \$721.46 | \$707.93 | \$702.62 | \$688.59 | \$700.86 | \$717.25 |
| Costs (shift 3):      | \$576.65 | \$626.58 | \$614.74 | \$609.49 | \$595.52 | \$607.90 | \$624.01 |
| CPU, total:           | 4805 sec | 5081 sec | 4864 sec | 4975 sec | 4871 sec | 4896 sec | 5041 sec |
| CPU, virtual:         | 3756 sec | 3795 sec | 3727 sec | 3725 sec | 3722 sec | 3718 sec | 3729 sec |
| CPU, good (1):        | 3876 sec | 3933 sec | 3823 sec | 3830 sec | 3799 sec | 3752 sec | 3787 sec |
| Memory Units:         | 30098    | 33338    | 32700    | 32354    | 31429    | 32264    | 33313    |
| Page Faults:          | 375078   | 408798   | 396836   | 400224   | 390169   | 400351   | 418517   |

## tfm meters:

|               |        |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|
| Page Faults:  | 16.62% | 19.46% | 18.27% | 19.52% | 18.52% | 18.61% | 20.11% |
| Getwork:      | 1.64%  | 1.37%  | 1.38%  | 1.39%  | 1.38%  | 1.35%  | 1.38%  |
| Seg Faults:   | 0.08%  | 0.04%  | 0.34%  | 0.23%  | 0.34%  | 0.98%  | 0.81%  |
| Bound Faults: | -0.03% | -0.02% | 0.01%  | -0.04% | -0.01% | 0.01%  | 0.01%  |
| Interrupts:   | 1.47%  | 2.22%  | 1.25%  | 2.00%  | 1.32%  | 1.36%  | 2.10%  |
| Idle, zero:   | 9.53%  | 8.55%  | 9.86%  | 8.10%  | 9.27%  | 10.55% | 8.47%  |
| Idle, HP:     | 0.00%  | 0.01%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.01%  |
| Idle, NMP:    | 0.14%  | 0.14%  | 0.12%  | 0.14%  | 0.10%  | 0.09%  | 0.19%  |
| Idle, total:  | 9.67%  | 8.70%  | 9.98%  | 8.24%  | 9.37%  | 10.64% | 8.67%  |
| Other (good): | 70.55% | 68.24% | 68.78% | 68.65% | 69.07% | 67.05% | 66.94% |

## dvm meters:

|                      |         |         |         |         |         |         |         |
|----------------------|---------|---------|---------|---------|---------|---------|---------|
| Bulk Reads:          | 381857  | 420245  | 401757  | 405714  | 393699  | 402044  | 423363  |
| Bulk Writes:         | 168767  | 173475  | 174689  | 168641  | 174484  | 175675  | 174484  |
| Bulk ATB I/O:        | 10.000  | 9.756   | 9.653   | 9.724   | 9.697   | 9.698   | 9.480   |
| Bulk Avg. Page Wait: | .588    | .655    | .575    | .650    | .588    | .587    | .652    |
| D190 Reads:          | 5277    | 5438    | 5584    | 5614    | 5925    | 6681    | 6672    |
| D190 Writes:         | 3709    | 38839   | 3853    | 36811   | 4184    | 4222    | 37145   |
| D190 ATB I/O:        | 612.758 | 130.817 | 589.628 | 131.651 | 545.020 | 513.860 | 129.346 |
| D190 Avg. Page Wait: | 30.833  | 37.500  | 30.643  | 41.099  | 30.620  | 30.851  | 46.136  |

## Notes:

(1) Based on Elapsed Time \* percentage good (tfm meters)

# Metering Comparisons for 22.0a, 23.2, 23.3, 23.4a, 23.5b

| System:               | 22.0a    | 23.2      | 23.3      | 23.4a     | 23.5b     | 23.5b     | 23.5b     | 23.5b     | 23.5b     |
|-----------------------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Date:                 | 01/21/74 | 02/25/74  | 02/25/74  | 02/28/74  | 03/11/74  | 03/13/74  | 03/16/74  | 03/17/74  | 03/18/74  |
| Write-through status: | dlrs     | dlrs      | dlrs      | dlrs      | dlrs      | dlrs      | dlrs      | dlrs      | dlrs      |
| Device Checkings:     | 1        | 1         | 1         | 1         | 1         | 1         | 1         | 1         | 1         |
| Disk Channels:        | 1        | 2         | 2         | 2         | 2         | 2         | 2         | 2         | 2         |
| SYST card:            | 0        | 0         | 0         | 0         | 2         | 2         | 0         | 0         | 0         |
| TEFIRST               | 1        | 1         | 1         | 1         | 1         | 1         | 2         | 1         | 1         |
| TELAST                | 1        | 1         | 1         | 1         | 1         | 1         | 2         | 1         | 1         |
| Interface:            | none     | none      | none      | none      | none      | 2-way     | none      | none      | 2-way     |
| Paging Device Size:   | 2048K    | 2048K     | 2048K     | 2048K     | 2048K     | 2048K     | 2048K     | 2048K     | 2048K     |
| Elapsed Time:         | 94.3 min | 102.7 min | 104.5 min | 104.2 min | 104.4 min | 104.4 min | 100.3 min | 101.6 min | 100.9 min |
| Costs (shift 1):      | \$779.41 | \$859.81  | \$937.56  | \$946.99  | \$960.34  | \$949.59  | \$900.21  | \$959.42  | \$942.07  |
| Costs (shift 2):      | \$717.25 | \$796.33  | \$873.49  | \$882.89  | \$896.42  | \$885.91  | \$837.40  | \$896.05  | \$879.31  |
| Costs (shift 3):      | \$624.01 | \$701.10  | \$777.38  | \$786.74  | \$800.55  | \$790.39  | \$743.17  | \$800.99  | \$785.17  |
| CPU, total:           | 5041 sec | 5323 sec  | 5495 sec  | 5583 sec  | 5568 sec  | 5566 sec  | 5326 sec  | 5494 sec  | 5413 sec  |
| CPU, virtual:         | 3729 sec | 3809 sec  | 3844 sec  | 3845 sec  | 3835 sec  | 3821 sec  | 3769 sec  | 3803 sec  | 3766 sec  |
| CPU, good (1):        | 3787 sec | 3837 sec  | 3860 sec  | 3905 sec  | 3949 sec  | 3943 sec  | 3893 sec  | 3924 sec  | 3871 sec  |
| Memory Units:         | 33313    | 38276     | 43282     | 43903     | 44848     | 44202     | 41169     | 44949     | 43977     |
| Page Faults:          | 418517   | 474469    | 531088    | 541744    | 551310    | 553807    | 505820    | 547945    | 538499    |

## tfm meters:

|               |        |        |        |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Page Faults:  | 20.11% | 20.57% | 22.39% | 23.18% | 23.88% | 24.07% | 22.86% | 24.50% | 23.93% |
| Getwork:      | 1.38%  | 1.28%  | 1.33%  | 1.47%  | 1.61%  | 1.56%  | 1.23%  | 1.34%  | 1.33%  |
| Seg Faults:   | 0.81%  | 0.39%  | 0.33%  | 0.28%  | -0.07% | -0.10% | 0.24%  | 0.25%  | 0.18%  |
| Bound Faults: | 0.01%  | -0.01% | -0.01% | -0.02% | -0.08% | -0.06% | -0.05% | -0.03% | -0.04% |
| Interrupts:   | 2.10%  | 2.46%  | 2.36%  | 3.29%  | 2.56%  | 2.47%  | 2.38%  | 2.31%  | 2.25%  |
| Idle, zero:   | 8.47%  | 12.74% | 11.60% | 9.05%  | 8.82%  | 9.00%  | 8.36%  | 6.99%  | 8.18%  |
| Idle, MP:     | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  |
| Idle, NMP:    | 0.19%  | 0.34%  | 0.41%  | 0.31%  | 0.20%  | 0.12%  | 0.25%  | 0.29%  | 0.25%  |
| Idle, total:  | 8.67%  | 13.08% | 12.01% | 9.36%  | 9.02%  | 9.12%  | 8.61%  | 7.28%  | 8.43%  |
| Other (good): | 66.94% | 62.24% | 61.57% | 62.44% | 63.06% | 62.93% | 64.72% | 64.36% | 63.92% |

## dvm meters:

|                        |         |         |         |         |         |         |         |         |         |
|------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Bulk Reads:            | 423363  | 490611  | 552235  | 574167  | 559446  | 561864  | 517298  | 557376  | 544759  |
| Bulk Writes:           | 174484  | 196770  | 214950  | 221333  | 212674  | 211561  | 196270  | 209788  | 208442  |
| Bulk ATB I/O:          | 9.480   | 9.356   | 8.605   | 8.291   | 8.127   | 8.118   | 8.437   | 7.955   | 8.048   |
| Bulk Avg. Page Wait:   | .652    | .654    | .654    | .654    | .655    | .661    | .653    | .657    | .657    |
| Bulk EDAC Corr Errors: | 0       | 18863   | 14609   | 0       | 0       | 0       | 0       | 0       | 0       |
| D190 Reads:            | 6672    | 8180    | 9208    | 9248    | 9303    | 8992    | 8529    | 9098    | 8928    |
| D190 Writes:           | 37145   | 43831   | 46999   | 48911   | 47143   | 48958   | 44749   | 47523   | 46760   |
| D190 ATB I/O:          | 129.346 | 123.650 | 117.455 | 113.410 | 111.165 | 108.340 | 113.003 | 107.786 | 108.851 |
| D190 Avg. Page Wait:   | 46.136  | 43.657  | 45.411  | 43.638  | 42.820  | 39.963  | 39.962  | 43.646  | 42.453  |

## Notes:

(1) Based on Elapsed Time \* percentage good (tfm meters)



# Metering Comparisons for 23.5b, 23.6, 23.7

| System:               | 23.5b    | 23.6     | 23.6     | 23.6     | 23.6     | 23.7     | 23.6     | 23.6     |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Date:                 | 03/18/74 | 03/21/74 | 03/24/74 | 03/25/74 | 04/03/74 | 04/04/74 | 04/06/74 | 04/07/74 |
| Write-through status: | dirs     | dirs     | dirs     | dirs     | dirs     | dirs     | dirs     | dirs     |
| Device Checking:      | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        |
| Disk Channels:        | 2        | 1        | 2        | 2        | 2        | 2        | 2        | 2        |
| SYST Card:            | 0        | 0        | 0        | 0        | 0        | 0        | 0        | 0        |
| TEFIRST:              | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        |
| TELAST:               | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        |
| Reset Working Set:    | on       | on       | off      | on       | on       | on       | on       | on       |
| External Interface:   | 2-way    | none     | none     | none     | none     | none     | none     | none     |
| Paging Device Size:   | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    |

|                  |           |           |           |           |           |           |           |          |
|------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|
| Elapsed Time:    | 100.9 min | 104.8 min | 102.3 min | 101.1 min | 101.4 min | 101.0 min | 100.0 min | 96.9 min |
| Costs (shift 1): | \$942.07  | \$959.87  | \$947.30  | \$936.65  | \$940.71  | \$946.18  | \$987.30  | \$887.98 |
| Costs (shift 2): | \$879.31  | \$896.33  | \$884.39  | \$873.70  | \$878.00  | \$883.34  | \$926.70  | \$827.01 |
| Costs (shift 3): | \$785.17  | \$801.01  | \$790.01  | \$779.29  | \$783.94  | \$789.08  | \$835.80  | \$735.57 |
| CPU, total:      | 5413 sec  | 5538 sec  | 5419 sec  | 5409 sec  | 5387 sec  | 5416 sec  | 5408 sec  | 5201 sec |
| CPU, virtual:    | 3766 sec  | 3813 sec  | 3775 sec  | 3776 sec  | 3763 sec  | 3770 sec  | 3636 sec  | 3658 sec |
| CPU, good (1):   | 3871 sec  | 3932 sec  | 3886 sec  | 3887 sec  | 3879 sec  | 3878 sec  | 3744 sec  | 3733 sec |
| Memory Units:    | 43977     | 44928     | 44278     | 43560     | 43901     | 44227     | 47640     | 40909    |
| Page Faults:     | 538499    | 552578    | 537923    | 534128    | 530239    | 534925    | 578445    | 499525   |

## tfm meters:

|               |        |        |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Page Faults:  | 23.93% | 24.01% | 23.57% | 23.73% | 23.43% | 23.64% | 25.97% | 23.21% |
| Getwork:      | 1.33%  | 1.33%  | 1.32%  | 1.36%  | 1.30%  | 1.43%  | 1.38%  | 1.33%  |
| Seg Faults:   | 0.18%  | 0.19%  | 0.23%  | 0.17%  | 0.24%  | 0.11%  | 0.17%  | 0.26%  |
| Bound Faults: | -0.04% | -0.04% | -0.05% | -0.02% | -0.02% | -0.04% | -0.04% | -0.03% |
| Interrupts:   | 2.25%  | 2.46%  | 2.21%  | 2.23%  | 2.24%  | 2.39%  | 2.54%  | 2.13%  |
| Idle, zero:   | 8.18%  | 9.27%  | 9.15%  | 8.18%  | 8.76%  | 8.19%  | 7.24%  | 8.60%  |
| Idle, MP:     | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  |
| Idle, NMP:    | 0.25%  | 0.26%  | 0.25%  | 0.24%  | 0.31%  | 0.29%  | 0.34%  | 0.27%  |
| Idle, total:  | 8.43%  | 9.53%  | 9.40%  | 8.42%  | 9.07%  | 8.48%  | 7.58%  | 8.87%  |
| Other (good): | 63.92% | 62.51% | 63.30% | 64.11% | 63.74% | 64.00% | 62.40% | 64.23% |

## dvm meters:

|                      |         |         |         |         |         |         |         |         |
|----------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| Bulk Reads:          | 544759  | 562434  | 545682  | 541447  | 537481  | 541493  | 587324  | 502501  |
| Bulk Writest:        | 208442  | 214052  | 208686  | 207953  | 204277  | 207285  | 225226  | 198879  |
| Bulk ATB I/O:        | 8.048   | 8.120   | 8.144   | 8.473   | 8.208   | 8.105   | 7.392   | 8.301   |
| Bulk Avg. Page Wait: | .657    | .657    | .653    | .654    | .650    | .654    | .654    | .653    |
| D191 Reads:          | 8928    | 9467    | 8661    | 9037    | 8652    | 8890    | 9398    | 8281    |
| D191 Writest:        | 46760   | 47760   | 47015   | 46556   | 46597   | 46844   | 50177   | 43587   |
| D191 ATB I/O:        | 108.851 | 110.176 | 110.342 | 110.044 | 110.200 | 108.895 | 100.822 | 112.252 |
| D191 Avg. Page Wait: | 42.453  | 45.065  | 45.101  | 41.423  | 42.211  | 41.910  | 49.355  | 39.814  |

## Notes:

(1) Based on Elapsed Time \* percentage good (tfm meters)

# Metering Comparisons for 23.6, 23.7, 23.8, 23.9, 23.9a

| System:               | 23.6     | 23.6     | 23.7     | 23.8     | 23.8     | 23.8     | 23.9T    | 23.9a    |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Date:                 | 04/07/74 | 04/08/74 | 04/14/74 | 04/20/74 | 04/21/74 | 04/23/74 | 04/28/74 | 05/05/74 |
| Write-through status: | dirs     | dirs     | dirs     | dirs     | dirs     | dirs     | dirs     | dirs     |
| Device Checking:      | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        |
| CPU:                  | B        | A        | A        | A        | A        | A        | A        | A        |
| Memories:             | A,B      | A,B      | A,B      | A,B      | A,B      | A,B      | A,B      | A,B      |
| External Interface:   | none     | none     | none     | none     | none     | none     | none     | none     |
| Paging Device Size:   | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    |
| Disk Channels:        | 2        | 2        | 2        | 2        | 2        | 2        | 2        | 2        |
| Online EIS Operators: | no       | no       | yes      | yes      | no       | no       | no       | no       |

|                  |          |          |          |          |          |          |          |          |
|------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Elapsed Time:    | 96.9 min | 96.2 min | 96.2 min | 93.7 min | 93.6 min | 95.0 min | 91.8 min | 89.2 min |
| Costs (shift 1): | \$887.98 | \$889.39 | \$884.30 | \$881.58 | \$859.59 | \$846.79 | \$794.81 | \$798.35 |
| Costs (shift 2): | \$827.01 | \$829.00 | \$824.22 | \$823.24 | \$801.40 | \$788.59 | \$736.80 | \$742.49 |
| Costs (shift 3): | \$735.57 | \$738.43 | \$734.10 | \$735.72 | \$714.12 | \$701.30 | \$649.79 | \$658.69 |
| CPU, total:      | 5201 sec | 5160 sec | 5111 sec | 5045 sec | 4993 sec | 4975 sec | 4782 sec | 4696 sec |
| CPU, virtual:    | 3658 sec | 3623 sec | 3605 sec | 3501 sec | 3491 sec | 3492 sec | 3480 sec | 3352 sec |
| CPU, good (1):   | 3733 sec | 3713 sec | 3718 sec | 3446 sec | 3436 sec | 3451 sec | 3402 sec | 3274 sec |
| Memory Units:    | 40909    | 41178    | 40929    | 41269    | 39850    | 38994    | 35585    | 36464    |
| Page Faults:     | 499525   | 504261   | 494747   | 510085   | 495276   | 486576   | 425098   | 439061   |

## ttm meters:

|               |        |        |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Page Faults:  | 23.21% | 23.41% | 22.85% | 24.22% | 23.56% | 22.93% | 20.76% | 22.04% |
| Getwork:      | 1.33%  | 1.34%  | 1.38%  | 1.34%  | 1.34%  | 1.35%  | 1.34%  | 1.39%  |
| Seg Faults:   | 0.26%  | 0.28%  | 0.10%  | 2.69%  | 2.79%  | 2.65%  | 2.99%  | 2.92%  |
| Bound Faults: | -0.03% | -0.01% | -0.05% | 0.22%  | 0.23%  | 0.22%  | 0.22%  | 0.22%  |
| Interrupts:   | 2.13%  | 2.11%  | 2.15%  | 2.14%  | 2.20%  | 2.27%  | 2.08%  | 2.07%  |
| Idle, zero:   | 8.60%  | 7.11%  | 9.00%  | 7.90%  | 8.44%  | 9.81%  | 10.71% | 10.00% |
| Idle, MP:     | 0.00%  | 0.01%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  | 0.00%  |
| Idle, NMP:    | 0.27%  | 1.42%  | 0.15%  | 0.23%  | 0.25%  | 0.24%  | 0.13%  | 0.21%  |
| Idle, total:  | 8.87%  | 8.54%  | 9.15%  | 8.13%  | 8.69%  | 10.05% | 10.84% | 10.21% |
| Other (good): | 64.23% | 64.35% | 64.41% | 61.26% | 61.20% | 60.53% | 61.76% | 61.15% |

## dvm meters:

|                      |         |         |         |         |         |         |         |         |
|----------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| Bulk Reads:          | 502501  | 509032  | 501663  | 516618  | 503086  | 495879  | 432869  | 444506  |
| Bulk Writes:         | 198879  | 201225  | 194680  | 200553  | 191728  | 190599  | 171040  | 176510  |
| Bulk ATB I/O:        | 8.301   | 8.137   | 8.295   | 7.853   | 8.090   | 8.311   | 9.126   | 8.633   |
| Bulk Avg. Page Wait: | .653    | .652    | .646    | .649    | .649    | .649    | .645    | .647    |
| D191 Reads:          | 8281    | 8048    | 6813    | 7721    | 7627    | 7845    | 5971    | 6962    |
| D191 Writes:         | 43587   | 44137   | 43544   | 44798   | 43628   | 43004   | 38375   | 38842   |
| D191 ATB I/O:        | 112.252 | 110.753 | 114.707 | 107.241 | 109.665 | 112.206 | 124.283 | 117.043 |
| D191 Avg. Page Wait: | 39.814  | 46.795  | 35.807  | 41.071  | 41.559  | 38.601  | 31.460  | 38.052  |

## Notes:

(1) Based on Elapsed Time \* percentage good (ttm meters)

(2) The EIS fortran and PL/I compilers were installed May 1, 1974

# Metering Comparisons for 23.9a, 23.10, 23.10a

| System:               | 23.9a    | 23.9a    | 23.10    | 23.10a   |
|-----------------------|----------|----------|----------|----------|
| Date:                 | 05/05/74 | 05/12/74 | 05/18/74 | 06/01/74 |
| Write-through status: | dirs     | dirs     | dirs     | dirs     |
| Device Checking:      | 1        | 1        | 1        | 1        |
| CPU:                  | A        | A        | A        | A        |
| Memories:             | A,B      | A,B      | A,B      | A,B      |
| External Interface:   | none     | none     | none     | none     |
| Paging Device Size:   | 2048K    | 2048K    | 2048K    | 2048K    |
| Disk Channels:        | 2        | 2        | 2        | 2        |
| Online EIS Operators: | no       | no       | no       | no       |
| Elapsed Time:         | 89.2 min | 87.5 min | 86.8 min | 87.8 min |
| Costs (shift 1):      | \$798.35 | \$801.36 | \$767.10 | \$765.47 |
| Costs (shift 2):      | \$742.49 | \$745.78 | \$711.06 | \$709.16 |
| Costs (shift 3):      | \$658.69 | \$662.39 | \$627.01 | \$624.69 |
| CPU, total:           | 4696 sec | 4661 sec | 4498 sec | 4508 sec |
| CPU, virtual:         | 3352 sec | 3335 sec | 3362 sec | 3379 sec |
| CPU, good (1):        | 3274 sec | 3273 sec | 3224 sec | 3253 sec |
| Memory Units:         | 36464    | 36748    | 34329    | 34138    |
| Page Faults:          | 439061   | 437423   | 415164   | 411510   |

## tfm meters:

|               |        |        |        |        |
|---------------|--------|--------|--------|--------|
| Page Faults:  | 22.04% | 22.35% | 19.19% | 18.97% |
| Getwork:      | 1.39%  | 1.30%  | 1.49%  | 2.10%  |
| Seg Faults:   | 2.92%  | 2.96%  | 2.96%  | 2.92%  |
| Bound Faults: | 0.22%  | 0.23%  | 0.29%  | 0.30%  |
| Interrupts:   | 2.07%  | 2.11%  | 1.95%  | 2.01%  |
| Idle, zero:   | 10.00% | 8.46%  | 12.04% | 11.73% |
| Idle, MP:     | 0.00%  | 0.00%  | 0.00%  | 0.02%  |
| Idle, NMP:    | 0.21%  | 0.23%  | 0.16%  | 0.22%  |
| Idle, total:  | 10.21% | 8.69%  | 12.20% | 11.97% |
| Other (good): | 61.15% | 62.36% | 61.92% | 61.75% |

## dvm meters:

|                      |         |         |         |         |
|----------------------|---------|---------|---------|---------|
| Bulk Reads:          | 444506  | 445862  | 420287  | 421177  |
| Bulk Writes:         | 176510  | 174049  | 219487  | 222737  |
| Bulk ATB I/O:        | 8.633   | 8.479   | 8.143   | 8.185   |
| Bulk Avg. Page Wait: | .647    | .646    | .633    | .616    |
| D191 Reads:          | 6962    | 6088    | 6602    | 6646    |
| D191 Writes:         | 38842   | 38979   | 28392   | 27216   |
| D191 ATB I/O:        | 117.043 | 116.628 | 148.875 | 155.653 |
| D191 Avg. Page Wait: | 38.052  | 39.414  | 36.121  | 41.789  |

## Notes:

(1) Based on Elapsed Time \* percentage good (tfm meters)

# Metering Comparisons for 23.12a, 23.13, 23.13a

| System:               | 23.12a   | 23.12a   | 23.12a   | 23.12a   | 23.13     | 23.13a   | 23.13a   | 23.13a   | 23.13a   |
|-----------------------|----------|----------|----------|----------|-----------|----------|----------|----------|----------|
| Date:                 | 07/01/74 | 07/03/74 | 07/06/74 | 07/07/74 | 07/11/74  | 07/13/74 | 07/14/74 | 07/14/74 | 07/22/74 |
| Script:               | script2  | script1  | script2  | script2  | script2   | script1  | script2  | script2  | script1  |
| Write-through status: | dirs     | dirs     | none     | dirs     | none      | none     | dirs     | dirs     | dirs     |
| Device Checking:      | 1        | 1        | 1        | 1        | 1         | 1        | 1        | 1        | 1        |
| CPU:                  | A        | A        | A        | B        | B         | A        | A        | A        | A        |
| Memories:             | A,B      | A,B      | B,C      | B,C      | B,C       | A,B      | A,B      | A,B      | A,B      |
| External Interface:   | off      | off      | off      | off      | off       | off      | off      | off      | off      |
| Paging Device Size:   | 2048K    | 2048K    | 2048K    | 2048K    | 2048K     | 2048K    | 2048K    | 2048K    | 2048K    |
| Disk Channels:        | 2,4      | 2,4      | 2,4      | 2,4      | 2,4       | 2,4      | 2,4      | 2,8      | 2,8      |
| Elapsed Time:         | 97.8 min | 86.6 min | 95.6 min | 99.7 min | 97.7 min  | 83.5 min | 96.1 min | 97.2 min | 87.1 min |
| Costs (shift 1):      | \$976.96 | \$923.81 | \$988.86 | \$995.41 | \$1020.83 | \$883.29 | \$977.86 | \$977.88 | \$915.20 |
| Costs (shift 2):      | \$804.17 | \$760.47 | \$814.18 | \$819.47 | \$840.76  | \$727.24 | \$805.06 | \$805.07 | \$753.79 |
| Costs (shift 3):      | \$420.92 | \$398.09 | \$426.33 | \$429.02 | \$440.46  | \$380.80 | \$421.51 | \$421.51 | \$394.91 |
| CPU, total:           | 5443 sec | 4542 sec | 5358 sec | 5569 sec | 5453 sec  | 4216 sec | 5318 sec | 5403 sec | 4394 sec |
| CPU, virtual:         | 3589 sec | 3372 sec | 3555 sec | 3614 sec | 3575 sec  | 3179 sec | 3536 sec | 3539 sec | 3198 sec |
| CPU, good (1):        | 3528 sec | 3260 sec | 3508 sec | 3573 sec | 3503 sec  | 3053 sec | 3479 sec | 3495 sec | 3068 sec |
| Memory Units:         | 37662    | 35710    | 38477    | 38566    | 40161     | 34352    | 37953    | 37943    | 36040    |
| Page Faults:          | 545980   | 427964   | 555215   | 561393   | 573269    | 408233   | 524773   | 530750   | 433491   |

## tfm meters:

|                |        |        |        |        |        |        |        |        |        |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Page Faults:   | 26.52% | 19.90% | 26.76% | 27.25% | 27.24% | 18.85% | 26.04% | 27.26% | 20.35% |
| Getwork:       | 2.40%  | 2.16%  | 2.50%  | 2.42%  | 2.47%  | 2.15%  | 2.46%  | 2.40%  | 2.19%  |
| Seg Faults:    | 2.58%  | 2.88%  | 2.59%  | 2.54%  | 2.75%  | 2.96%  | 2.61%  | 2.59%  | 2.98%  |
| Bound Faults:  | 0.50%  | 0.29%  | 0.50%  | 0.49%  | 0.50%  | 0.31%  | 0.50%  | 0.50%  | 0.30%  |
| Interrupts:    | 4.62%  | 2.06%  | 4.00%  | 4.85%  | 4.15%  | 1.35%  | 4.59%  | 4.41%  | 1.97%  |
| Idle, zero:    | 0.23%  | 9.77%  | 0.13%  | 0.29%  | 0.41%  | 13.22% | 0.23%  | 0.33%  | 13.31% |
| Idle, MP:      | 2.81%  | 0.01%  | 2.17%  | 2.24%  | 2.49%  | 0.02%  | 3.06%  | 2.41%  | 0.03%  |
| Idle, NMP:     | 0.02%  | 0.21%  | 0.04%  | 0.04%  | 0.03%  | 0.16%  | 0.04%  | 0.02%  | 0.21%  |
| Idle, Loading: | 0.20%  | 0.00%  | 0.17%  | 0.19%  | 0.20%  | 0.00%  | 0.16%  | 0.15%  | 0.00%  |
| Idle, total:   | 3.26%  | 9.99%  | 2.51%  | 2.76%  | 3.19%  | 13.40% | 3.49%  | 2.90%  | 13.55% |
| Other (good):  | 60.13% | 62.72% | 61.15% | 59.70% | 59.76% | 60.98% | 60.31% | 59.93% | 58.67% |

## dvm meters:

|                      |        |         |        |        |        |         |        |        |         |
|----------------------|--------|---------|--------|--------|--------|---------|--------|--------|---------|
| Bulk Reads:          | 548743 | 439352  | 561271 | 568411 | 580431 | 418634  | 531407 | 540665 | 442886  |
| Bulk Writes:         | 300168 | 223214  | 300035 | 305814 | 308525 | 213215  | 286231 | 292691 | 227555  |
| Bulk ATB I/O:        | 6.925  | 7.857   | 6.662  | 6.858  | 6.608  | 7.930   | 7.071  | 7.004  | 7.802   |
| Bulk Avg. Page Wait: | .625   | .619    | .572   | .629   | .577   | .557    | .620   | .633   | .632    |
| D191 Reads:          | 51519  | 6738    | 54003  | 55701  | 55983  | 5854    | 49038  | 49610  | 7199    |
| D191 Writes:         | 73681  | 28647   | 48316  | 77823  | 50131  | 4624    | 70901  | 71067  | 29621   |
| D191 ATB I/O:        | 46.955 | 147.129 | 56.079 | 44.905 | 55.361 | 478.257 | 48.207 | 48.368 | 142.072 |
| D191 Avg. Page Wait: | 48.704 | 39.435  | 42.900 | 47.594 | 44.244 | 30.201  | 49.180 | 47.969 | 40.186  |

## Notes:

(1) Based on Elapsed Time \* percentage good (tfm meters)

# Metering Comparisons for 23.13a, 23.13b, 23.14a, 23.14c

| System:               | 23.13a   | 23.13a   | 23.13a   | 23.13b   | 23.13b   | 23.14a   | 23.14a   | 23.14a   | 23.14c   |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Date:                 | 07/22/74 | 07/25/74 | 07/27/74 | 07/29/74 | 07/29/74 | 07/31/74 | 08/01/74 | 08/03/74 | 08/07/74 |
| Script:               | script1  | script1  | script2  | script1  | script2  | script2  | script2  | script2  | script1  |
| Write-through status: | dirs     | none     | none     | dirs     | dirs     | none     | dirs     | none     | none     |
| Device Checking:      | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        |
| CPU:                  | A        | A        | A        | A        | A        | B        | B        | A        | A        |
| Memories:             | A,B      | A,B      | A,B      | A,B      | A,B      | A,B      | A,B      | A,B      | A,B      |
| External Interface:   | off      | off      | off      | off      | off      | off      | off      | off      | off      |
| Paging Device Size:   | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    |
| Disk Channels:        | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      |
| Elapsed Time:         | 87.1 min | 82.5 min | 95.5 min | 87.2 min | 98.7 min | 96.1 min | 99.3 min | 94.8 min | 82.7 min |
| Costs (shift 1):      | \$915.20 | \$911.07 | \$985.44 | \$913.79 | \$993.39 | \$997.75 | \$985.10 | \$973.60 | \$930.01 |
| Costs (shift 2):      | \$753.79 | \$750.36 | \$811.36 | \$752.64 | \$818.01 | \$821.51 | \$810.96 | \$801.54 | \$766.02 |
| Costs (shift 3):      | \$394.91 | \$393.10 | \$424.85 | \$394.33 | \$428.42 | \$430.19 | \$424.55 | \$419.66 | \$401.36 |
| CPU, total:           | 4394 sec | 4272 sec | 5376 sec | 4384 sec | 5544 sec | 5361 sec | 5524 sec | 5296 sec | 4339 sec |
| CPU, virtual:         | 3198 sec | 3190 sec | 3543 sec | 3186 sec | 3533 sec | 3579 sec | 3585 sec | 3524 sec | 3233 sec |
| CPU, good (1):        | 3068 sec | 3057 sec | 3480 sec | 3055 sec | 3471 sec | 3508 sec | 5903 sec | 3457 sec | 3096 sec |
| Memory Units:         | 36040    | 35844    | 38344    | 36015    | 38833    | 38860    | 38130    | 37775    | 36699    |
| Page Faults:          | 433491   | 426160   | 548588   | 433825   | 562663   | 525823   | 531525   | 518887   | 432924   |

## tfm meters:

|                |        |        |        |        |        |        |        |        |        |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Page Faults:   | 20.35% | 19.95% | 27.40% | 20.36% | 28.54% | 26.39% | 27.29% | 26.58% | 20.28% |
| Getwork:       | 2.19%  | 2.20%  | 2.45%  | 2.16%  | 2.44%  | 2.62%  | 2.63%  | 2.63%  | 2.38%  |
| Seg Faults:    | 2.98%  | 3.08%  | 2.70%  | 2.91%  | 2.50%  | 2.60%  | 2.56%  | 2.69%  | 3.19%  |
| Bound Faults:  | 0.30%  | 0.32%  | 0.50%  | 0.29%  | 0.49%  | 0.49%  | 0.49%  | 0.50%  | 0.31%  |
| Interrupts:    | 1.97%  | 1.30%  | 3.80%  | 2.01%  | 4.64%  | 3.76%  | 4.55%  | 3.87%  | 1.32%  |
| Idle, zero:    | 13.31% | 11.22% | 0.31%  | 13.65% | 0.37%  | 0.16%  | 0.38%  | 0.00%  | 9.85%  |
| Idle, MP:      | 0.03%  | 0.02%  | 1.95%  | 0.02%  | 2.21%  | 2.91%  | 2.82%  | 2.79%  | 0.06%  |
| Idle, NMP:     | 0.21%  | 0.17%  | 0.02%  | 0.24%  | 0.04%  | 0.03%  | 0.04%  | 0.00%  | 0.21%  |
| Idle, Loading: | 0.00%  | 0.00%  | 0.16%  | 0.00%  | 0.17%  | 0.20%  | 0.22%  | 0.19%  | 0.00%  |
| Idle, total:   | 13.55% | 11.41% | 2.44%  | 13.91% | 2.79%  | 3.30%  | 3.46%  | 2.98%  | 10.12% |
| Other (good):  | 58.67% | 61.75% | 60.71% | 58.36% | 58.60% | 60.83% | 59.03% | 60.75% | 62.41% |

## dvm meters:

|                      |         |         |        |         |        |        |        |        |         |
|----------------------|---------|---------|--------|---------|--------|--------|--------|--------|---------|
| Bulk Reads:          | 442886  | 434883  | 552615 | 443752  | 565318 | 531359 | 537605 | 523620 | 443061  |
| Bulk Writes:         | 227555  | 220040  | 300038 | 228178  | 307263 | 287152 | 295351 | 288480 | 222989  |
| Bulk ATB I/O:        | 7.802   | 7.565   | 6.728  | 7.794   | 6.791  | 7.050  | 7.154  | 7.011  | 7.452   |
| Bulk Avg. Page Wait: | 0.632   | 0.557   | 0.571  | 0.635   | 0.639  | 0.574  | 0.644  | 0.573  | 0.561   |
| D191 Reads:          | 7199    | 6773    | 53412  | 7317    | 56216  | 51399  | 54163  | 54513  | 6989    |
| D191 Writes:         | 29621   | 5212    | 46390  | 29632   | 77807  | 46211  | 76438  | 48484  | 5330    |
| D191 ATB I/O:        | 142.072 | 413.398 | 57.486 | 141.739 | 44.216 | 59.125 | 45.631 | 55.286 | 402.931 |
| D191 Avg. Page Wait: | 40.186  | 31.421  | 43.056 | 39.640  | 47.702 | 43.964 | 47.474 | 39.893 | 32.727  |

## Notes:

(1) Based on Elapsed Time \* percentage good (tfm meters)

# Metering Comparisons for 23.14c, 23.15, 23.15a, 23.16a

| System:               | 23.14c   | 23.14c   | 23.15    | 23.15a   | 23.15a   | 23.15a   | 23.16a   | 23.16a   |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|----------|
| Date:                 | 08/07/74 | 08/08/74 | 08/12/74 | 08/19/74 | 08/24/74 | 08/25/74 | 09/02/74 | 09/07/74 |
| Script:               | script1  | script2  | script2  | script2  | script1  | script2  | script1  | script2  |
| Write-through status: | none     | none     | none     | none     | none     | none     | none     | none     |
| Device Checking:      | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        |
| CPU:                  | A        | A        | A        | A        | A        | A        | A        | A        |
| Memories:             | A,B      | A,B      | A,B      | A,B      | B,C      | B,C      | B,C      | B,C      |
| External Interface:   | off      | off      | off      | off      | off      | off      | off      | off      |
| Paging Device Size:   | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    |
| Disk Channels:        | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      |
| Elapsed Time:         | 82.7 min | 95.0 min | 91.1 min | 95.2 min | 86.3 min | 93.7 min | 85.6 min | 96.2 min |
| Costs (shift 1):      | \$930.01 | \$974.33 | \$983.29 | \$984.72 | \$921.86 | \$980.32 | \$918.70 | \$983.16 |
| Costs (shift 2):      | \$766.02 | \$802.16 | \$809.60 | \$810.78 | \$758.79 | \$807.19 | \$756.66 | \$809.42 |
| Costs (shift 3):      | \$401.36 | \$419.99 | \$423.94 | \$424.56 | \$397.52 | \$422.72 | \$396.41 | \$423.79 |
| CPU, total:           | 4339 sec | 5295 sec | 5294 sec | 5351 sec | 4324 sec | 5287 sec | 4315 sec | 5370 sec |
| CPU, virtual:         | 3233 sec | 3521 sec | 3530 sec | 3536 sec | 3226 sec | 3504 sec | 3215 sec | 3557 sec |
| CPU, good (1):        | 3096 sec | 3435 sec | 3323 sec | 3451 sec | 3086 sec | 3404 sec | 3073 sec | 3475 sec |
| Memory Units:         | 36699    | 37828    | 38283    | 38339    | 36247    | 38238    | 36156    | 38154    |
| Page Faults:          | 432924   | 520152   | 523713   | 534962   | 424266   | 521467   | 424601   | 526810   |

## tfm meters:

|                |        |        |        |        |        |        |        |        |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Page Faults:   | 20.28% | 26.52% | 26.44% | 26.98% | 19.14% | 26.75% | 19.31% | 26.70% |
| Getwork:       | 2.38%  | 2.65%  | 2.60%  | 2.65%  | 2.32%  | 2.72%  | 2.37%  | 2.72%  |
| Seg Faults:    | 3.19%  | 2.64%  | 2.57%  | 2.59%  | 3.15%  | 2.69%  | 3.14%  | 2.67%  |
| Bound Faults:  | 0.31%  | 0.50%  | 0.51%  | 0.50%  | 0.31%  | 0.49%  | 0.31%  | 0.49%  |
| Interrupts:    | 1.32%  | 3.85%  | 3.78%  | 3.83%  | 1.35%  | 3.96%  | 1.36%  | 3.91%  |
| Idle, zero:    | 9.85%  | 0.00%  | 0.10%  | 0.01%  | 13.94% | 0.10%  | 13.48% | 0.01%  |
| Idle, MP:      | 0.06%  | 3.38%  | 3.00%  | 2.79%  | 0.05%  | 2.52%  | 0.05%  | 3.09%  |
| Idle, NMP:     | 0.21%  | 0.01%  | 0.02%  | 0.02%  | 0.15%  | 0.02%  | 0.13%  | 0.00%  |
| Idle, Loading: | 0.00%  | 0.21%  | 0.20%  | 0.21%  | 0.00%  | 0.18%  | 0.00%  | 0.20%  |
| Idle, total:   | 10.12% | 3.60%  | 3.32%  | 3.03%  | 14.14% | 2.82%  | 13.66% | 3.30%  |
| Other (good):  | 62.41% | 60.25% | 60.79% | 60.42% | 59.60% | 60.57% | 59.85% | 60.20% |

## dvm meters:

|                      |         |        |        |        |         |        |         |        |
|----------------------|---------|--------|--------|--------|---------|--------|---------|--------|
| Bulk Reads:          | 443061  | 523230 | 529434 | 536666 | 434509  | 524184 | 434760  | 530568 |
| Bulk Writes:         | 222989  | 289264 | 290465 | 294026 | 223337  | 288277 | 223533  | 294944 |
| Bulk ATB I/O:        | 7.452   | 7.023  | 6.955  | 6.880  | 7.874   | 6.920  | 7.803   | 6.995  |
| Bulk Avg. Page Wait: | 0.561   | 0.573  | 0.569  | 0.572  | 0.558   | 0.570  | 0.558   | 0.572  |
| D191 Reads:          | 6989    | 53002  | 51958  | 54132  | 6852    | 52574  | 6743    | 52783  |
| D191 Writes:         | 5330    | 48065  | 46805  | 47715  | 5299    | 47366  | 5274    | 46369  |
| D191 ATB I/O:        | 402.931 | 56.464 | 57.743 | 56.121 | 426.341 | 56.257 | 427.474 | 58.246 |
| D191 Avg. Page Wait: | 32.727  | 45.805 | 44.566 | 43.553 | 30.375  | 39.693 | 32.097  | 43.595 |

## Notes:

(1) Based on Elapsed Time \* percentage good (tfm meters)

# Metering Comparisons for 23.16a, 23.17a, 23.18a, 23.19a, 23.20a, 24.0a

| System:               | 23.16a   | 23.17a   | 23.18a   | 23.19a   | 23.19a   | 23.20a   | 23.20a   | 24.0a    | 24.0a    |
|-----------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Date:                 | 09/07/74 | 09/08/74 | 09/26/74 | 09/28/74 | 09/30/74 | 10/02/74 | 10/06/74 | 10/07/74 | 10/10/74 |
| Script:               | script2  | script1  | script2  | script1  | script2  | script2  | script2  | script2  | script2  |
| Write-through status: | none     | none     | none     | none     | none     | none     | none     | none     | none     |
| Device Checking:      | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        | 1        |
| SYST:                 | 0        | 0        | 2        | 2        | 2        | 2        | 2        | 0        | 2        |
| CPU:                  | A        | B        | A        | A        | A        | A        | A        | A        | B        |
| Memories:             | B,C      | B,C      | A,B      | A,B      | A,B      | A,B      | C,B      | A,B      | B,C      |
| External Interface:   | off      | off      | off      | off      | off      | off      | off      | off      | off      |
| Paging Device Size:   | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    | 2048K    |
| Disk Channels:        | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      | 2,8      |
| Elapsed Time:         | 96.2 min | 85.9 min | 96.5 min | 82.1 min | 91.3 min | 93.3 min | 93.5 min | 93.3 min | 93.1 min |
| Costs (shift 1):      | \$983.16 | \$915.48 | \$965.51 | \$978.16 | \$942.26 | \$951.48 | \$947.52 | \$954.04 | \$951.42 |
| Costs (shift 2):      | \$809.42 | \$753.92 | \$794.67 | \$806.54 | \$775.89 | \$783.53 | \$780.26 | \$785.64 | \$783.49 |
| Costs (shift 3):      | \$423.79 | \$394.91 | \$415.88 | \$423.27 | \$406.34 | \$410.39 | \$408.66 | \$411.50 | \$410.37 |
| CPU, total:           | 5370 sec | 4358 sec | 5356 sec | 4272 sec | 5101 sec | 5168 sec | 5160 sec | 5161 sec | 5148 sec |
| CPU, virtual:         | 3557 sec | 3231 sec | 3573 sec | 3096 sec | 3358 sec | 3372 sec | 3365 sec | 3380 sec | 3369 sec |
| CPU, good (1):        | 3475 sec | 3085 sec | 3493 sec | 2961 sec | 3283 sec | 3273 sec | 3285 sec | 3281 sec | 3290 sec |
| Memory Units:         | 38154    | 35903    | 37097    | 40010    | 36801    | 37248    | 37061    | 37353    | 37257    |
| Page Faults:          | 526810   | 428298   | 512297   | 462285   | 515566   | 527493   | 520608   | 520255   | 522747   |

## ftm meters:

|                |        |        |        |        |        |        |        |        |        |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Page Faults:   | 26.70% | 19.53% | 26.05% | 21.50% | 26.86% | 27.06% | 27.05% | 27.17% | 27.08% |
| Getwork:       | 2.72%  | 2.45%  | 2.79%  | 2.64%  | 2.88%  | 2.90%  | 2.94%  | 2.70%  | 2.83%  |
| Seg Faults:    | 2.67%  | 3.11%  | 2.66%  | 3.10%  | 2.54%  | 2.71%  | 2.72%  | 2.77%  | 2.70%  |
| Bound Faults:  | 0.49%  | 0.32%  | 0.49%  | 0.29%  | 0.51%  | 0.48%  | 0.48%  | 0.48%  | 0.49%  |
| Interrupts:    | 3.91%  | 1.60%  | 4.02%  | 1.56%  | 4.01%  | 4.14%  | 4.51%  | 3.98%  | 4.08%  |
| Idle, zero:    | 0.01%  | 12.89% | 0.09%  | 10.48% | 0.05%  | 0.15%  | 0.13%  | 0.19%  | 0.21%  |
| Idle, MP:      | 3.09%  | 0.07%  | 3.39%  | 0.07%  | 2.96%  | 3.82%  | 3.36%  | 3.80%  | 3.43%  |
| Idle, NMP:     | 0.00%  | 0.20%  | 0.00%  | 0.25%  | 0.01%  | 0.01%  | 0.02%  | 0.02%  | 0.05%  |
| Idle, Loading: | 0.20%  | 0.00%  | 0.20%  | 0.00%  | 0.24%  | 0.28%  | 0.24%  | 0.27%  | 0.25%  |
| Idle, total:   | 3.30%  | 13.16% | 3.68%  | 10.80% | 3.26%  | 4.26%  | 3.75%  | 4.28%  | 3.94%  |
| Other (good):  | 60.20% | 59.85% | 60.31% | 60.11% | 59.94% | 58.46% | 58.54% | 58.61% | 58.88% |

## dvm meters:

|                      |        |         |        |         |        |        |        |        |        |
|----------------------|--------|---------|--------|---------|--------|--------|--------|--------|--------|
| Bulk Reads:          | 530568 | 438986  | 518082 | 472987  | 519532 | 530984 | 531750 | 524972 | 530927 |
| Bulk Writes:         | 294944 | 224055  | 290996 | 232249  | 284287 | 296377 | 298138 | 295739 | 297000 |
| Bulk ATB I/O:        | 6.995  | 7.781   | 7.162  | 6.988   | 6.816  | 6.771  | 6.767  | 6.825  | 6.753  |
| Bulk Avg. Page Wait: | 0.572  | 0.561   | 0.576  | 0.561   | 0.571  | 0.572  | 0.568  | 0.568  | 0.566  |
| D191 Reads:          | 52783  | 7084    | 51117  | 7499    | 52851  | 55479  | 56893  | 56245  | 53336  |
| D191 Writes:         | 46369  | 5686    | 46461  | 5621    | 48446  | 50656  | 51904  | 51396  | 48867  |
| D191 ATB I/O:        | 58.246 | 404.024 | 59.388 | 375.642 | 54.092 | 52.783 | 51.621 | 52.040 | 54.708 |
| D191 Avg. Page Wait: | 43.595 | 33.786  | 45.847 | 31.123  | 41.824 | 46.747 | 41.116 | 45.635 | 45.479 |

## Notes:

(1) Based on Elapsed Time \* percentage good (ftm meters)