JSC-16467

HIGH DENSITY TAPE REFORMATTING SYSTEM/LANDSAT IMAGERY VERIFICATION AND EXTRACTION SYSTEM (HDTRS/LIVES) THROUGHPUT ANALYSIS

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1. PURPOSE

This analysis has been performed to provide a measurement of the time required to process HDT segments and full scenes through the LIVES software/hardware/procedural system.

2. INTRODUCTION

2.1 PREPARATION

Special forms were designed and provided, along with instructions, to Data Management and Operations personnel for the recording of the data required for analysis. (See Figures 1 and 2).

2.2 DATA SOURCES

All information used in this analysis was obtained from the forms completed by the Data Management and Operations personnel, the DUL reports, and the PDP 11/45 Support Processor on-line console print out.

2.3 ANALYSIS TEST PERIOD

The data used in this analysis was accumulated over a thirty-nine (39) day period (13 November 1979 - 21 December 1979), in conjunction with the thirty-one (31) segment test carried out by the Data Management Section.

FIGURE 1

GHIT/HDT RECEIVING

AND HANDLING LOG

☐ GHIT ☐ HDT ID NUMBERS(S)

STEP	DATE	TIME
1 RECEIVED		
2 GSCRN START		
STOP		
3 LOGGED IN LIBRARY		
4 OUT TO USDA		
5 IN FROM USDA		
COMMENTS:		

HDTRS/LIVES

THROUGHPUT ANALYSIS LOG

FIGURE 2

GHIT ID(s)	HDT ID(s)	

STEP		DATE	TIME
1 BATCH REQUEST FORM RECEIVED			
2 REQUESTED TAPES ASSEMBLED			
3 GHIT PROCESSOR	START		
	STOP		
4 EXTRACT PROCESSOR	START		
	STOP		
5 CONDITIONING PROCESSOR	START		
	STOP		
6 CCT GENERATION	START		
	STOP		
7 DATA MANAGEMENT NOTIFIED - CCT AVAILABLE			
8 DLYRPT	START		
	STOP		
9 ARCHIVE	START		
	STOP		

COMMENTS:

3. DISCUSSION

All findings and data presentations within this report, reflect the conditions under which the 31 segment test was run. It should be understood beforehand that this test served multitudinous purposes. Many problems were encountered, addressed, and resolved. These included software, hardware, and procedural aspects of the system. During the course of this test, there were eight (8) discrepancy reports (DR's) opened, of which, four (4) were hardware related, three (3) were software related, and one (1) was procedural related. These DR's were the direct cause of fourteen (14) days non-production time during this test.

In addition, there were three (3) Landsat Image Verification and Extraction System (LIVES) software transmittal/information request forms (TIRF's) in work,one of which has a significant impact on the system's overall throughput capability.

The test also served to provide an operational learning curve and as an opportunity to evaluate and tune up Domestic (DOMSAT)/Quad Systems Incorporated (QSI)/High Density Tape Reformatting System (HDTRS)/LIVES operating procedures.

This test period should definitely be viewed as a "shake down" era for all of the hardware, software, and procedural elements which comprise the system. Therefore, the analysis results should not be construed as reflective of what could be expected in a steady state production environment.

4. ANALYSIS CONSIDERATIONS

There were four (4) primary elements identified for analysis. These included the receiving and handling of Goddard HDT Inventory Tapes (GHIT), the receiving and handling of HDT's, selected segment processing, and full scene processing.

4.1 GHIT HANDLING

This portion of the study was done to understand the characteristics of GHIT handling. Data accumulated included the date and time that the tapes were received, logged to the library, sent to the United States Department of Agriculture (USDA), returned from the USDA, and processed through the GSCRN Processor.

Of the total number of tapes received during the test period, only 8.3% of the tapes were actually used for segment processing attempts and only 5.5% of the tapes were used in successfully completed segment processing.

The primary importance of this analysis, was to determine the nominal availability of GHIT's for segment processing. The results of this analysis are shown as follows.

During the six week period of the test, there were 348 GHIT's received. This is an average of 58 tapes per week or 12.4 tapes per day. It should be noted that GHIT tapes are only received on week days and only on the day shift.

After the tapes for a given day are received, they are run through the GSCRN Processor, which averages approximately 8.5 minutes. Usually, this is followed by logging that day's group of tapes into the library, then they are picked up for delivery to the USDA, and finally returned for storage in a little over two days.

The following is a typical scenario for GHIT handling. (The dates shown are only used as a point of reference).

GHIT's RECEIVED			GSCRN	GHIT's LOGGED		
Date	Start	Stop	Processor	Date	Start	Stop
11/13	0920	1041	8.5 minutes	11/13	1302	1342

GHIT's TO USDA		GHIT's FROM USDA	
Date	Time	Date	Time
11/13	1404	11/15	1457

4.2 HDT HANDLING

This portion of the study was done to understand the characteristics of HDT handling. Data accumulated included the date and time that tapes were received, logged to the library, sent to the USDA, and returned from the USDA.

Of the total number of HDT's received during the test period, only 9.6% of the HDT's were actually used for segment processing attempts and only 6.3% of the HDT's were used in successfully completed processing.

The primary importance of this analysis, was to determine the nominal availability of HDT's for segment processing. The results of this analysis are shown as follows:

During the six week period of the test, there were 302 logical HDT's received on 140 physical tapes. This represents an average of 2.2 logical HDT's per tape. The average number of logical HDT's received per week was 50.3 or an average of 7.9 per day. HDT's are received everyday, typically beginning on the third shift and ending on the day shift.

There is considerable variation in the time of HDT availability. The earliest time that tapes were completed was 0508 and the latest time that tapes were completed was 1000.

After the tapes for a given day are received, they are logged into the tape library, they are picked up by the USDA, and then returned for storage in a little over two days.

The following is a typical scenario for HDT handling. (The dates shown are only used as a point of reference).

HDT's RECEIVED		HDT's LOGGED	
Date	Completed	Date	Time
11/13	0801	11/13	1108

HDT's TO USDA		HDT's FROM USDA	
Date	Time	Date	Time
11/13	1431	11/15	1500

4.3 SELECTED SEGMENT PROCESSING

This portion of the study provides a view of the LIVES throughput capability under the conditions prevailing during the test period. The basis of this analysis is the processing cycle. Each processing cycle is initiated by the submission of a run request which specifies corresponding GHIT's and HDT's for processing through LIVES. Only one GHIT and HDT is used on a run request.

The presentation of the data in this section will be shown in four parts. The first part gives an overall perspective of the processing that took place during the test period. The second part reflects all processing cycles on a week to week basis. The third part presents a breakdown of processing cycles into the various software processors of the system. The fourth part depicts processing cycles based on the number of segments/areas of interest being processed.

Technically, a processing cycle could be considered to include the entire period from the time that the GHIT and/or HDT is initially received, through availability of the LIVES created computer-compatible tape (CCT). In reviewing this, it was found that the longest period was 28 days, 12 hours and 15 minutes and the shortest period was 8 days, 19 hours and 6 minutes. In conjunction with this, it was found that half of the processing cycles requested the use of GHIT's and HDT's which had been received at some time outside the bounds of the test period. Based on this, the availability of GHIT's and HDT's was not considered a significant impact on throughput. Therefore, the GHIT and HDT are considered to be available whenever the processing cycle is initiated.

4.3.1 OVERALL PERSPECTIVE

During this six week test period all processing was accomplished on week days only. Run cycles were processed on both day shift and third shift through the course of the test.

There were a total of 49 segment hits processed against 23 of the 31 test segments originally identified for the test.

Figure 3 provides an overall view of processing that took place during the test. The element that is identified as "Non-Machine Time" is comprised of time which elapses between consecutive LIVES processors which cannot be assigned to either the preceding or succeeding processor.

4.3.2 WEEKLY PROCESSING

This section provides a breakdown of the processing that took place during the test period, on a weekly basis. Figure 4 through 9 reflect the processing activity relative to each week of the test.

Week one (11/13-11/16) - There were no problems encountered which curtailed processing. This was the only week that all available days were used.

Week two (11/19-11/23) - Processing occurred on all but one available day. There were no run cycles submitted on that day.

LIVES PROCESSING ACTIVITY

WEEK NUMBER ALL

DAYS AVAILABLE	DAYS USED	DAYS LOST
28	14	14

RUNS SUBMITTED	RUNS SUCCESSFUL	SUCCESS RATE	SEGMENT HITS PROCESSED
30	20	66.7%	49

TOTAL TIME RECORDED	TOTAL MACHINE TIME	TOTAL NON-MACHINE TIME
26:08 (100%) (100%)	19:01 (72.8%) (100%)	7:07 (27.2%) (100%)

TOTAL TIME PRODUCTIVE	TOTAL MACHINE TIME PRODUCTIVE	TOTAL NON-MACHINE TIME PRODUCTIVE
13:47 (100%) (52.7%)	11:34 (83.9%) (60.8%)	2:13 (16.1%) (31.1%)

TOTAL TIME LOST	TOTAL MACHINE TIME LOST	TOTAL NON-MACHINE TIME LOST
12:21 (100%) (47.3%)	7:27 (60.3%) (39.2%)	4:54 (39.7%) (68.9%)

Figure 3

LIVES PROCESSING ACTIVITY

WEEK NUMBER 1

DAYS AVAILABLE	DAYS USED	DAYS LOST
4	4	0

RUNS SUBMITTED	RUNS SUCCESSFUL	SUCCESS RATE	SEGMENT HITS PROCESSED
6	2	33.3%	5

TOTAL TIME RECORDED	TOTAL MACHINE TIME	TOTAL NON-MACHINE TIME
4:35 (100%) (100%)	3:07 (68.0%) (100%)	1:28 (32.0%) (100%)

TOTAL TIME PRODUCTIVE	TOTAL MACHINE TIME PRODUCTIVE	TOTAL NON-MACHINE TIME PRODUCTIVE
1:51 (100%) (40.4%)	:54 (48.6%) (28.9%)	:57 (51.4%) (64.8%)

TOTAL TIME LOST	TOTAL MACHINE TIME LOST	TOTAL NON-MACHINE TIME LOST
2:44 (100%) (59.6%)	2:13 (81.1%) (71.1%)	:31 (18.9%) (35.2%)

Figure 4

LIVES PROCESSING ACTIVITY

WEEK NUMBER 2

DAYS AVAILABLE	DAYS USED	DAYS LOST
4	3	1

RUNS SUBMITTED	RUNS SUCCESSFUL	SUCCESS RATE	SEGMENT HITS PROCESSED
6	4	66.7%	7

TOTAL TIME RECORDED	TOTAL MACHINE TIME	TOTAL NON-MACHINE TIME
5:47 (100%) (100%)	3:58 (68.6%) (100%)	1:49 (31.4%) (100%)

TOTAL TIME PRODUCTIVE	TOTAL MACHINE TIME PRODUCTIVE	TOTAL NON-MACHINE TIME PRODUCTIVE
3:49 (100%) (66.0%)	2:56 (76.9%) (73.9%)	:53 (23.1%) (48.6%)

TOTAL TIME LOST	TOTAL MACHINE TIME LOST	TOTAL NON-MACHINE TIME LOST
1:58 (100%) (34.0%)	1:02 (52.5%) (26.1%)	:56 (47.5%) (51.4%)

Figure 5

LIVES PROCESSING ACTIVITY

WEEK NUMBER 3

DAYS AVAILABLE	DAYS USED	DAYS LOST
5	2	3

RUNS SUBMITTED	RUNS SUCCESSFUL	SUCCESS RATE	SEGMENT HITS PROCESSED
2	1	50.0%	4

TOTAL TIME RECORDED	TOTAL MACHINE TIME	TOTAL NON-MACHINE TIME
2:06 (100%) (100%)	1:16 (60.3%) (100%)	:50 (39.7%) (100%)

TOTAL TIME PRODUCTIVE	TOTAL MACHINE TIME PRODUCTIVE	TOTAL NON-MACHINE TIME PRODUCTIVE
:48 (100%) (38.1%)	:40 (83.3%) (52.6%)	:08 (16.7%) (16.0%)

TOTAL TIME LOST	TOTAL MACHINE TIME LOST	TOTAL NON-MACHINE TIME LOST
1:18 (100%) (61.9%)	:36 (46.2%) (47.4%)	:42 (53.8%) (84.0%)

Figure 6

LIVES PROCESSING ACTIVITY

WEEK NUMBER 4

DAYS AVAILABLE	DAYS USED	DAYS LOST
5	1	4

RUNS SUBMITTED	RUNS SUCCESSFUL	SUCCESS RATE	SEGMENT HITS PROCESSED
1	0	(.0%)	0

TOTAL TIME RECORDED	TOTAL MACHINE TIME	TOTAL NON-MACHINE TIME
:54 (100%) (100%)	:42 (77.8%) (100%)	:12 (22.2%) (100%)

TOTAL TIME PRODUCTIVE	TOTAL MACHINE TIME PRODUCTIVE	TOTAL NON-MACHINE TIME PRODUCTIVE
:00 (-) (0%)	:00 (-) (0%)	:00 (-) (0%)

TOTAL TIME LOST	TOTAL MACHINE TIME LOST	TOTAL NON-MACHINE TIME LOST
:54 (100%) (100%)	:42 (77.8%) (100%)	:12 (22.2%) (100%)

Figure 7

LIVES PROCESSING ACTIVITY

WEEK NUMBER 5

DAYS AVAILABLE	DAYS USED	DAYS LOST
5	4	1

RUNS SUBMITTED	RUNS SUCCESSFUL	SUCCESS RATE	SEGMENT HITS PROCESSED
15	13	86.7%	33

TOTAL TIME RECORDED	TOTAL MACHINE TIME	TOTAL NON-MACHINE TIME
12:46 (100%) (100%)	9:58 (78.1%) (100%)	2:48 (21.9%) (100%)

TOTAL TIME PRODUCTIVE	TOTAL MACHINE TIME PRODUCTIVE	TOTAL NON-MACHINE TIME PRODUCTIVE
7:19 (100%) (57.3%)	7:04 (96.6%) (70.9%)	:15 (3.4%) (8.9%)

TOTAL TIME LOST	TOTAL MACHINE TIME LOST	TOTAL NON-MACHINE TIME LOST
5:27 (100%) (42.7%)	2:54 (53.2%) (29.1%)	2:33 (46.8%) (91.1%)

Figure 8

LIVES PROCESSING ACTIVITY

WEEK NUMBER 6

DAYS AVAILABLE	DAYS USED	DAYS LOST
5	0	5

RUNS SUBMITTED	RUNS SUCCESSFUL	SUCCESS RATE	SEGMENT HITS PROCESSED
0	0	0	0

TOTAL TIME RECORDED	TOTAL MACHINE TIME	TOTAL NON-MACHINE TIME
0	0	0

TOTAL TIME PRODUCTIVE	TOTAL MACHINE TIME PRODUCTIVE	TOTAL NON-MACHINE TIME PRODUCTIVE
0	0	0

TOTAL TIME LOST	TOTAL MACHINE TIME LOST	TOTAL NON-MACHINE TIME LOST
0	0	0

Figure 9

Week three (11/26-11/30) - Two days were used, with only one being productive. Three days were not used at all, due to a hardware problem.

Week Four (12/13-12/17) - Only one day was used during this week, but with no productive results. Four days were not used due to the hardware problem mentioned in week three.

Week Five (12/10-12/14) - One day of this week was lost due to the hardware problem previously mentioned. The remaining four days were used productively.

Week six (12/17-12/21) - There was no processing during this week. Three days were lost due to a procedural problem and two days were lost due to a software problem.

4.3.3 LIVES PROCESSORS

The run cycles are comprised of six (6) processors. The run time for each of these processors was accumulated in order to construct an average run cycle time for each GHIT/HDT submitted. Only the run cycles that were successfully completed were considered, in order that a nominal time line could be observed. In conjunction with this, it was found that a typical amount of "Non-Machine Time" existed between each processor. This time has been factored in with the machine time used, to provide the following results: (NOTE: All times are rounded to the nearest half minute).

RUN TIME PER LIVES PROCESSOR

LIVES PROCESSOR NAME	MACHINE TIME USED	NON-MACHINE TIME USED
GHIT	10.5	7.5
EXTRACT	13.0	.5
CONDITIONING	3.5	.5
CCT GENER	5.0	1.5
DAILY REPT.	1.5	.5
ARCHIVE	2.0	
TOTAL	35.5	10.5
TIMELINE	46.0	

4.3.4 SEGMENT VARIATION

Run cycles were viewed from the standpoint of the effect that the number of Areas-of-Interest (AOI)/Segments had on the time required to process each cycle. This was only considered for those cycles which were successfully completed. The breakdown which follows, depicts the machine time required to run each LIVES processor, based on the number of AOI/Segments. The "Non-Machine Time" factor which was found to be fairly constant throughout, is added separately. The final number shown is the average amount of time required to run each segment per run cycle. It can easily be seen, that an increase in the number of segments in the run cycle increases time usage efficiency. The run cycles completed, included samples of 1, 2, 3, 4, and 8 AOI/segments. (Note: All times are rounded to the nearest half minute)

AREAS OF INTEREST/SEGMENTS PER RUN CYCLE

LIVES PROCESSOR (Machine Time)	1 AOI	2 AOI	3 AOI	4 AOI	8 AOI
GHIT	8.5	10.5	12.5	15.5	10.5
EXTRACT	10.5	9.5	16.5	7.5	33.5
CONDITIONING	3.0	2.5	3.0	4.0	6.5
CCT GENER.	6.5	3.0	3.5	2.5	6.0
DAILY REPT.	1.5	1.5	1.5	2.5	1.5
ARCHIVE	1.5	1.0	1.5	5.0	1.0
Total Machine Time Required	31.5	28.0	38.5	37.0	59.0
"Non Machine" Time	10.5	10.5	10.5	10.5	10.5
Total Time Required	42.0	39.5	49.0	47 5	69.5
Time Per AOI/Segment	42.0	19.8	16.7	11.9	8.7

4.4 FULL SCENE PROCESSING

In conjunction with the 31 segment test, notification was received that full scene processing should be considered a standard daily requirement. Therefore, data from two run cycles for full scene processing was obtained and examined. In comparing the processing times of the total run cycle, as well as the six (6) component processors, it was found that in all cases, the time measurements were extremely close. The results of full scene processing is presented on the following page and is broken down by the LIVES processor. In addition, the average processing time is shown.

FULL SCENE PROCESSING COMPARISON

LIVES Processor	First Full Scene	Second Full Scene	Average Full Scene
GHIT	:13	:13	:13
EXTRACT	1:07	1:04	1:05.5
CONDITIONING	:01	:01	:01
CCT GENER.	1:24	1:20	1:22
DAILY REPT.	:01	:02	:01.5
ARCHIVE	:02	:02	:02
TOTAL	2:48	2:42	2:45

5. THROUGHPUT CAPABILITY

Based on the data analyzed in terms of run cycles of selected segment and full scene processing, throughput capability can be projected.

5.1 SELECTED SEGMENT PROJECTION

The understood requirement was to have been, at least 30 segments processed each day. During the 31 segment test, the average segments processed was approximately 2.5 per run cycle. In order to attain 30 segments each day, it would be necessary to submit and process 12 run cycles per day. Since each run cycle averaged 46 minutes, the total amount of time required to process 30 segments would be 9 hours and 12 minutes.

5.2 FULL SCENE PROJECTION

It has been indicated that there may be a requirement to process one full scene each day, in addition to the 30 segment requirement. As shown in section 4, the time required to process a full scene through LIVES is 2 hours and 45 minutes.

5.3 OVERALL PROJECTIONS

The following projections are provided on the basis of timing factors presented previously.

5.3.1 PROCESSING 30 SEGMENTS AND ONE FULL SCENE

This projection assumes that stated requirements will be accomplished, unconstrained by time considerations. In order to process 30 segments and one full scene per day, a total of 11 hours and 57 minutes or approximately one and a half shifts will be required each day. This projection is also provided in Figure 10 as "Projection 1".

SELECTED SEGMENT AND FULL SCENE
PROCESSING PROJECTIONS

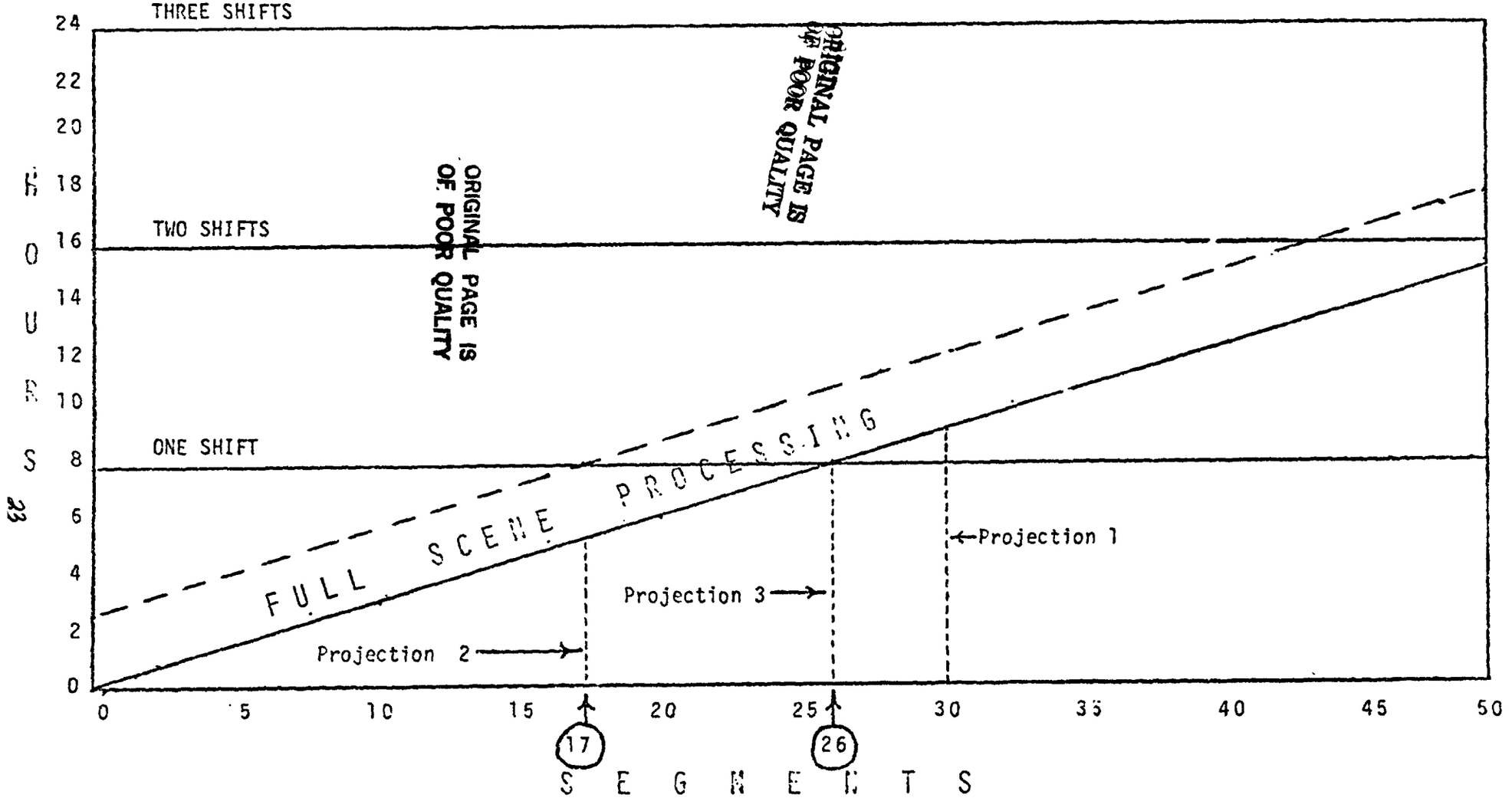

Figure 10

5.3.2 ONE SHIFT PROCESSING WITH ONE FULL SCENE

This projection assumes a limitation to processing of eight hours or one shift. It also assumes that one full scene run cycle will be required. Since the full scene uses 2 hours and 45 minutes, the remaining 5 hours and 15 minutes will allow the processing of no more than 17 segments each day. This projection is also provided in Figure 10 as "Projection 2".

5.3.3 ONE SHIFT PROCESSING WITH NO FULL SCENE

This projection assumes a limitation to processing of eight hours or one shift. It also assumes that no full scenes will be processed. During one eight hour shift, 26 segments may be processed. This projection is also provided in Figure 10 as "Projection 3".

6. CONCLUSIONS

The data obtained through this test indicates a low expection for satisfying a 30 segment and one full scene processing requirement each day. However, there are several reasons to believe that changes to various characteristics observed in this test would have considerable effect on throughput capability. Some of these aspects include the following considerations.

- In this test, the basically small number of areas of interest used, reduced considerably the possible number of segment hits that could be obtained for processing. In actual production, the number of segment hits per day would be much higher on each GHIT/HDT set. As has been shown, this has the effect of reducing the average time to process each segment.

- A software change is being implemented that will allow the processing of all GHIT tapes in a single run each day. This capability eliminates the necessity of processing a large number of run cycles each day and will reduce machine requirements significantly.

- Operations personnel have been provided an extremely valuable opportunity to familiarize themselves with the overall HDT/LIVES processing environment. This will assuredly result in more efficient handling of the system flow and reduced "Non-Machine" time periods.

In the near future, a production test will be run which should introduce and make advantage of these aspects identified. The results of that test should provide a more representative production throughput capability for the HDT/LIVES system than shown from the 31 segment test.