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TECHNICAL MEMORANDUM

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

By

A. J. Bowen, Jr.
Systems Management Office

APPROVED BY:

R. M. Hinson, Project Manager
Systems Management Office

(E80-10319) HIGH DENSITY TAPE REFORMATTING SYSTEM/LANDSAT IMAGERY VERIFICATION AND EXTRACTION SYSTEM (HDTRS/LIVES) PRODUCTION TEST THROUGHPUT ANALYSIS (Lockheed Engineering and Management) 39 p

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1830 NASA ROAD 1, Houston, Texas 77058 • Tel (713) 333-5411

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CONTENTS

FIGURES

1. PURPOSE

This analysis has been performed to describe the anticipated throughput capability of the LIVES software/hardware/procedural system in the processing of HDT selected segments and full scenes.

2. BACKGROUND

During the period from November 13, 1979 through December 21, 1979, an HDT/LIVES processing test was performed. This test was referred to as the "31 Segment Test". The throughput considerations of that test were analyzed and documented in the "High Density Tape Reformatting System/Landsat Imagery Verification and Extraction System (HDTRS/LIVES) Throughput Analysis", JSC-16467, LEC-14548.

Enhancements incorporated into the system after the conclusion of the first test prompted the need for a second test. This would provide determination of the throughput and product improvements. This second test was known as the "LIVES Production Test".

3. INTRODUCTION

3.1 ANALYSIS TEST PERIOD

The data used in this analysis was accumulated over a seventeen (17) day period from January 28 through February 13, 1980. This period is referred to as the "LIVES Production Test".

3.2 PREPARATION

Special forms were developed and provided to the Data Management and Operations Sections. Data Management personnel were requested to initiate the first form (Figure 3.2-1) and submit it to Operations for followup. Operations personnel were requested to complete the second form (Figure 3.2-2) in conjunction with the first form obtained from Data Management.

3.3 DATA SOURCES

The information used in this analysis has been obtained from the aforementioned forms completed by the Data Management and Operations personnel, the DUL reports, the PDP 11/45 Support Processor on-line console print out, and the analysis report of the "31 Segment Test" referenced in Section 2.

HDTRS/LIVES

THROUGHPUT ANALYSIS LOG

GHIT ID(s)	HDT ID(s)	

STEP		DATE	TIME
1 GHIT PROCESSOR	START		
	STOP		
2 EXTRACT PROCESSOR	START		
	STOP		

COMMENTS:

Figure 3-2-1

HDTRS/LIVES

THROUGHPUT ANALYSIS LOG

GHIT ID(s)	HDT ID(s)	

STEP		DATE	TIME
1 CONDITIONING PROCESSOR	START		
	STOP		
2 CCT GENERATION – 01	START		
	STOP		
3 CCT GENERATION – 02	START		
	STOP		
4 DLYRPT	START		
	STOP		
5 ARCHIVE	START		
	STOP		

COMMENTS:

Figure 3.2-2

4. DISCUSSION

The data analysis presented in this report, reflects the conditions expected in the operational environment. In comparison with the "31 Segment Test", performed earlier, a major software improvement had been implemented prior to the start of this test period. This modification allowed the loading of mutliple GHIT tapes on one run rather than requiring a separate run for each tape. In the previous test only one GHIT and HDT could be run during a LIVES processing cycle. Therefore several LIVES cycles would have to be run in order to process all the data for one day. This change made it possible to process all GHIT/HDT data, for a particular day, in one LIVES processing cycle.

During the course of this test, there were eight (8) discrepancy reports (DR's) written while LIVES processing was being attempted. Of these, four (4) were hardware related, three (3) were LIVES software related, and one (1) was system software related.

Two of the DR hardware problems resulted in a total of two (2) days lost processing time. Other than this no significant amount of lost time occurred. This is a substantial improvement in comparison to the similar circumstances which existed during the previous test. Although the number and type of DR's that were written were the same, eight (8), the amount of time lost was significantly different. In the first test there were fourteen (14) days lost out of a thirty-nine (39) day test period (35.9%). In this test there were two (2) days lost out of a seventeen (17) day test period (11.8%).

The improvement in the lost time percentage, is viewed as a product of increased experience with the overall hardware/software/procedural system. There is currently a better understanding of the system, on the part of all personnel that perform supporting roles. There has also been reflected a considerable degree of attention levied upon operational problems. This assisted in expediting the problem analysis and resolution process.

5. ANALYSIS CONSIDERATIONS

There were two (2) basic areas identified for analysis. These included the selected segment processing cycles and full scene processing cycles.

5.1 SELECTED SEGMENT PROCESSING

This portion of the analysis provides a view of the LIVES through-put 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. One or more GHIT's and logical HDT's may be specified on a single request.

The data presented in this section is 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 an individual 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.

For the benefit of this analysis, a processing cycle is identified by a work request submission which defines a set of GHIT and HDT tapes for processing through LIVES. The GHIT is input to the GHIT Processor. This is followed by the EXTRACT Processor which selects HDT reformatted data. These are followed by the Conditioning Processor, the CCT Generation Processor, the Daily Report Processor, and the Archive Update Processor. After the running of the Archive Update Processor, the processing cycle is complete.

5.1.1 Overall Perspective

The processing cycles run during this test period, were accomplished during the week days only. Runs were made on both of the normal operating shifts.

There were a total of 389 segment hits against 234 test AOI's. A breakdown of the segment hits show that 70 were encountered on the 31 original test AOI's, known as User ID 1. The remaining 319 hits were encountered on the 203 added test AOI's, known as User ID 2.

An overall view of the processing that took place during the test period is offered in Figure 5.1-1.

5.1.2 Processing Cycles

This section provides a breakdown of the processing that took place during the test period, on an individual cycle basis. Figures 5.1-2 through 5.1-19 reflect the processing activity relative to each cycle submitted.

Of the twelve (12) days actually available for processing, two (2) were lost due to hardware problems. This represents an availability time of approximately 83.3%. This is a significant improvement over the "31 Segment Test" in which only 50% availability time was attained. Again, this is indicative of increased experience gained in dealing with and responding to the various hardware, software, and procedural problems that periodically occur.

5.1.3 LIVES Processors

A run cycle is composed of six (6) software processors. The run time for each of these processors was accumulated in order to construct an average time for the completion of each run cycle submitted. 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 results shown in Figure 5.1-20.

5.1.4 Segment Variation

Each run cycle was viewed from the standpoint of the effect that the number of Areas-of Interest (AOI) had on the time required for processing. All cycles completed were considered for this portion of the study. The breakdown which is shown in Figure 5.1-21 depicts the productive machine time required to run each LIVES processor, based on the number of AOI's. The "Non-Machine Time" factor is added separately. The resulting number reflects the total productive time required to process that run cycle. Following this, is a representation of the average time to process each AOI for that run cycle. Generally, it is noticeable that the average time to process decreases as the number of AOI's in the run cycle increase. This situation reflects an increasing time usage efficiency factor which is highly desirable.

OVERALL PROCESSING

Days Available	Days Used	Days Lost
12	10	2

Runs Processed	Average Runs Processed Per Day
18	1.5

Segments Processed	Average Segments Processed Per Day	Average Segments Processed Per Run
389	32.4	21.6

Total Time Recorded	Total Machine Time	Total Set-Up Time
56:23 (100%)	52:31 (93.1%) (100%)	3:52 (6.9%)

Total Machine Time Productive
37:55 (71.5%)

Total Machine Time Lost
14:58 (28.5%)

Figure 5.1-1

PROCESSING CYCLES

RUN CYCLE 1 SEGMENTS 12

TOTAL TIME USED	2:28	100%
TOTAL MACHINE TIME	2:21	95.3%
PRODUCTIVE	1:42	72.3%
LOST	:39	27.7%
TOTAL SET-UP TIME	:07	4.7%

Figure 5.1-2

PROCESSING CYCLES

RUN CYCLE 2 SEGMENTS 1

TOTAL TIME USED	1:04	100%
TOTAL MACHINE TIME	1:02	96.9%
PRODUCTIVE	:58	93.5%
LOST	:04	6.5%
TOTAL SET-UP TIME	:02	3.1%

Figure 5.1-3

PROCESSING CYCLES

RUN CYCLE 3 SEGMENTS 6

TOTAL TIME USED	2:11	100%
TOTAL MACHINE TIME	2:10	99.2%
PRODUCTIVE	1:03	48.5%
LOST	1:07	51.5%
TOTAL SET-UP TIME	:01	.8%

Figure 5.1-4

PROCESSING CYCLES

RUN CYCLE 4 SEGMENTS 11

TOTAL TIME USED	2:43	100%
TOTAL MACHINE TIME	2:29	91.4%
PRODUCTIVE	1:42	68.5%
LOST	:47	31.5%
TOTAL SET-UP TIME	:14	8.6%

Figure 5.1-5

PROCESSING CYCLES

RUN CYCLE 5 SEGMENTS 35

TOTAL TIME USED	2:01		100%
TOTAL MACHINE TIME	1:57		96.7%
PRODUCTIVE	1:48	92.3%	
LOST	:09	7.7%	
TOTAL SET-UP TIME	:04		3.3%

Figure 5.1-6

PROCESSING CYCLES

RUN CYCLE 6 SEGMENTS 8

TOTAL TIME USED	2:06	100%
TOTAL MACHINE TIME	1:38	77.8%
PRODUCTIVE	1:38	100%
LOST	:00	0%
TOTAL SET-UP TIME	:28	22.2%

Figure 5.1-7

15

PROCESSING CYCLES

RUN CYCLE 7 SEGMENTS 9

TOTAL TIME USED	2:34	100%
TOTAL MACHINE TIME	2:27	95.5%
PRODUCTIVE	1:32	62.6%
LOST	:55	37.4%
TOTAL SET-UP TIME	:07	4.5%

Figure 5.1-8

PROCESSING CYCLES

RUN CYCLE 8 SEGMENTS 5

TOTAL TIME USED	2:45	100%
TOTAL MACHINE TIME	2:41	97.6%
PRODUCTIVE	2:09	80.1%
LOST	:32	19.9%
TOTAL SET-UP TIME	:04	2.4%

Figure 5.1-9

PROCESSING CYCLES

RUN CYCLE 9 SEGMENTS 58

TOTAL TIME USED	5:10	100%
TOTAL MACHINE TIME	4:56	95.5%
PRODUCTIVE	3:40	74.3%
LOST	1:16	25.7%
TOTAL SET-UP TIME	:14	4.5%

Figure 5.1-10

PROCESSING CYCLES

RUN CYCLE 10 SEGMENTS 38

TOTAL TIME USED	3:11	100%
TOTAL MACHINE TIME	2:41	84.3%
PRODUCTIVE	2:08	79.5%
LOST	:33	20.5%
TOTAL SET-UP TIME	:30	15.7%

Figure 5.1-11

PROCESSING CYCLES

RUN CYCLE 11 SEGMENTS 21

TOTAL TIME USED	6:53	100%
TOTAL MACHINE TIME	6:34	95.4%
PRODUCTIVE	2:36	39.6%
LOST	3:58	60.4%
TOTAL SET-UP TIME	:19	4.6%

Figure 5.1-12

20

PROCESSING CYCLES

RUN CYCLE 12 SEGMENTS 48

TOTAL TIME USED	3:35	100%
TOTAL MACHINE TIME	3:09	87.9%
PRODUCTIVE	3:00	95.2%
LOST	:09	4.8%
TOTAL SET-UP TIME	:26	12.1%

Figure 5.1-13

PROCESSING CYCLES

RUN CYCLE 13 SEGMENTS 20

TOTAL TIME USED	3:57		100%
TOTAL MACHINE TIME	3:51		97.5%
PRODUCTIVE	2:46	71.9%	
LOST	1:05	28.1%	
TOTAL SET-UP TIME	:06		2.5%

Figure 5.1-14

PROCESSING CYCLES

RUN CYCLE 14 SEGMENTS 46

TOTAL TIME USED	4:16	100%
TOTAL MACHINE TIME	4:12	98.4%
PRODUCTIVE	3:25	85.3%
LOST	:37	14.7%
TOTAL SET-UP TIME	:04	1.6%

Figure 5.1-15

PROCESSING CYCLES

RUN CYCLE 15 SEGMENTS 28

TOTAL TIME USED	4:04	100%
TOTAL MACHINE TIME	4:00	98.4%
PRODUCTIVE	2:13	55.4%
LOST	1:47	44.6%
TOTAL SET-UP TIME	:04	1.6%

Figure 5.1-16

PROCESSING CYCLES

RUN CYCLE 16 SEGMENTS 25

TOTAL TIME USED	3:40	100%
TOTAL MACHINE TIME	3:17	89.5%
PRODUCTIVE	3:02	92.4%
LOST	:15	7.6%
TOTAL SET-UP TIME	:23	11.7%

Figure 5.1-17

PROCESSING CYCLES

RUN CYCLE 17 SEGMENTS 15

TOTAL TIME USED	2:51	100%
TOTAL MACHINE TIME	2:30	87.7%
PRODUCTIVE	1:25	56.7%
LOST	1:05	43.3%
TOTAL SET-UP TIME	:21	12.3%

Figure 5.1-18

PROCESSING CYCLES

RUN CYCLE 18 SEGMENTS 3

TOTAL TIME USED	:54		100%
TOTAL MACHINE TIME	:36		66.7%
PRODUCTIVE	:36	100%	
LOST	:00	0%	
TOTAL SET-UP TIME	:18		33.3%

Figure 5.1-19

RUN TIME PER LIVES PROCESSOR

LIVES PROCESSOR NAME	*MACHINE TIME USED	*NON-MACHINE TIME USED
GHIT	31.5	
		1.5
EXTRACT	114.5	
		7.0
CONDITIONING	9.5	
		3.0
CCT GENERATION	13.5	
		1.0
DAILY REPORT	3.0	
		.5
ARCHIVE	3.0	
TOTAL	175.0	13.0

THROUGHPUT 188.0/3:08:00

*All times are rounded to the nearest half minute.

Figure 5.1-20

RUN CYCLE PROCESSING TIME BY NUMBER OF SEGMENTS

NO. OF SEGMENTS	LIVES PROCESSORS						TOTAL MACHINE TIME REQUIRED	NON-MACHINE TIME	TOTAL TIME REQUIRED	TIME PER SEGMENT
	GHIT	EXTR	COND	CCTG	DLYR	ARCH				
1	:25	:24	:01	:02	:03	:03	:58	:02	1:00	1:00
3	:12	:13	:02	:04	:02	:03	:36	:18	:54	:18
5	1:00	:57	:01	:06	:02	:03	2:09	:04	2:13	:27
6	:16	:29	:02	:14	:01	:01	1:03	:01	1:04	:11
8	:15	1:12	:02	:04	:02	:03	1:38	:28	2:06	:16
9	:19	1:00	:01	:05	:03	:04	1:32	:07	1:39	:11
11	:28	1:03	:02	:03	:03	:03	1:42	:14	1:56	:11
12	:15	1:12	:03	:09	:01	:02	1:42	:07	1:49	:09
15	:34	:34	:04	:08	:02	:03	1:25	:21	1:46	:07
20	:43	1:46	:04	:07	:03	:03	2:46	:06	2:52	:09
21	:13	2:06	:05	:07	:03	:02	2:36	:19	2:55	:08
25	:57	1:29	:08	:20	:04	:04	3:02	:23	3:25	:08
28	:33	1:12	:08	:14	:04	:02	2:13	:04	2:17	:05
35	:11	1:12	:09	:11	:03	:02	1:48	:04	1:52	:03
38	:24	1:16	:11	:12	:03	:02	2:08	:30	2:38	:04
46	:55	2:02	:06	:19	:09	:04	3:25	:04	3:29	:05
48	:42	1:53	:03	:15	:03	:04	3:00	:26	3:26	:04
58	:33	2:17	:13	:27	:07	:03	3:40	:14	3:54	:04

27

Figure 5.1-21

5.2 FULL SCENE PROCESSING

In conjunction with this test, full scene processing was also accomplished. There were three (3) run cycles completed from which full scenes were extracted. Again, as in the "31 Segment Test" processing times for these cycles were very close. The results of full scene processing is shown in Figure 5.1-22. The data is broken down by LIVES processor and is shown in comparison with data from the "31 Segment Test".

FULL SCENE PROCESSING COMPARISON

LIVES PROCESSOR	"PRODUCTION TEST RESULTS" FIRST	SECOND	THIRD	"31 SEGMENT TEST RESULTS" FIRST	SECOND	AVERAGE TIME/SCENE
GHIT	:11	:12	:17	:13	:13	:13
EXTRACT	1:03	:56	:57	1:07	1:04	1:02
CONDITIONING	:05	:04	:01	:01	:01	:02
CCT GENERATION	1:10	1:08	1:24	1:24	1:20	1:17
DAILY REPORT	:01	:02	:02	:01	:02	:02
ARCHIVE	:02	:02	:02	:02	:02	:02
TOTAL	2.32	2:24	2:43	2:48	2:42	2:38

Figure 5.1-22

6. THROUGHPUT CAPABILITY PROJECTIONS

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

6.1 SELECTED SEGMENT PROJECTION

During the "Production Test", the average number of segments processed was approximately 21.6 per run cycle. The average number of run cycles processed was 1.5 per day. The average number of segments processed was 32.4 per day. Run cycles averaged 3 hours and 8 minutes each to process; for 1.5 run cycles this would be 4 hours and 42 minutes.

These numbers were used to determine the approximate amount of time required to support the anticipated production load. The number of primary AOI's in the Master Data Base is approximately 525, with an additional 300 sidelap AOI's. Based on the satellite's 18 day cycle, this results in an average availability of about 46 segments to be transmitted to JSC each day. Since HDT's are only scheduled for processing on 5 days of the 7 day week, this results in a total of approximately 64 segments to process each day. Of these, it is anticipated that perhaps 50% will be eliminated from processing consideration due to exceeding the specified cloud cover threshold. The actual number of segments to process, each day, becomes 32.

In conjunction with the "Production Test", it can be seen that the average segments run each day during the test and those expected during production are extremely close. The amount of time required to process the anticipated production is 4 hours and 39 minutes.

6.2 FULL SCENE PROJECTION

This projection is based on the data shown in Section 5 (Figure 5.1-22). The time required to process a full scene is expected to be 2 hours and 38 minutes, on the average.

6.3 OVERALL PROJECTIONS

The following projections are provided on the basis of timing factors previously presented. These projections are depicted in Figure 6.1-1.

6.3.1 Anticipated Production Processing

This projection assumes a daily processing requirement of 32 selected segments and one full scene each day. The total time required to process would be 7 hours and 17 minutes. This is labeled as "Projection 1".

6.3.2 One Shift Processing With One Full Scene

This projection reflects the number of selected segments which could be processed during one eight hour shift, in conjunction with the processing of one full scene. During one eight hour shift, it is expected that 37 segments could be processed. This is labeled as "Projection 2".

6.3.3 One SHift Processing With No Full Scene

This projection reflects the number of selected segments that could be processed during an eight hour shift. This assumes that there is no requirement to process a full scene. A total of 55 segments could be processed in one shift, through this method. This is labeled as Projection "3".

SELECTED SEGMENT AND FULL SCENE
PROCESSING PROJECTIONS

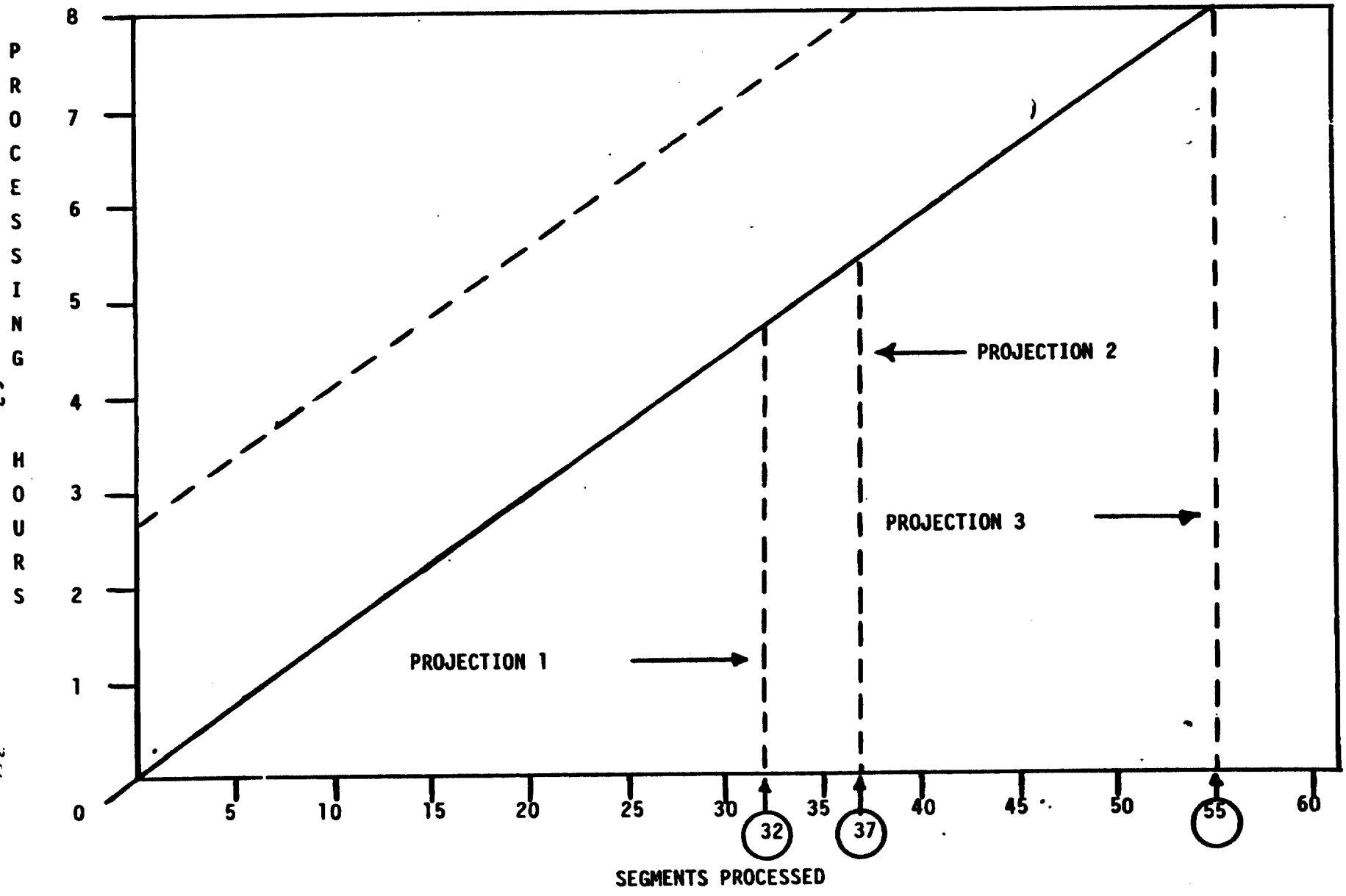

Figure 6.1-1

7. CONCLUSIONS

The data obtained through this test, when compared to the anticipated load of the production period, indicates a high expectation for satisfying daily requirements.

It should be noted that the projections in Section 6 reflect averages of total run cycles during the test. The number of segments held a high range variation in each run cycle; a low of 1 segment and a high of 58 segments.

In actual production, it would be expected that effective planning would be implemented to provide run cycle processing with only large numbers of segments. The basis for this statement is reflected in the data of Section 5 (Figure 5.1-21). Overall, each segment of each run cycle processed in an average of 8.7 minutes per segment. A further breakdown shows that those run cycles that contained fewer than 25 segments required an average of 10.9 minutes per segment, whereas those run cycles that contained 25 or more run cycles required only 4.5 minutes per segment.

As mentioned in the opening comment, data processing requirements should be adequately satisfied. But, attention to the segment level in each run cycle set-up should considerably reduce the overall machine time needed to satisfy those requirements.