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LARGE AREA CROP INVENTORY EXPERIMENT (LACIE)

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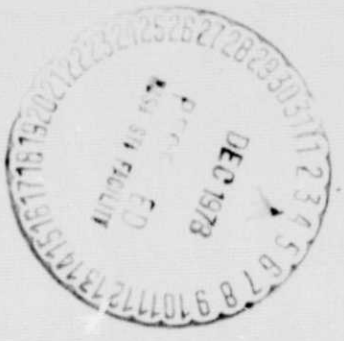
LACIE CAMS TRAINING PLAN



National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

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PREFACE

This document was prepared by the Earth Observations Division, Lyndon B. Johnson Space Center, Houston, Texas.

This document presents the plans to assure an adequate number of trained and certified analyst interpreters and data processing analysts to support LACIE in 1975 and 1976.

Acknowledgment is given to Lockheed Electronics Company, Inc. for the preparation of this document.

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1.0 INTRODUCTION

The Classification and Mensuration Subsystem (CAMS) for the Large Area Crop Inventory Experiment (LACIE) is being developed to achieve and maintain a capability to process and analyze large quantities of LANDSAT (formerly the Earth Resources Technology Satellite) data segments over a wide range of daily workload rates.

This document presents an overall plan to assure an adequate number of trained and certified analyst interpreters (AI's) and data processing analysts (DPA's) for the 1975 and 1976 era of LACIE.

During periods of light workloads, analysis personnel will be involved in on-the-job training and in performing functions related to CAMS development or CAMS testing and evaluation. It is expected that some personnel will achieve and maintain a higher level of analysis proficiency than others depending on their direct involvement in LACIE training and LACIE daily processing activities during these light workload periods.

Therefore, support personnel are categorized according to varying levels of proficiency. Training programs for four different initial levels of proficiency are established for both AI's and DPA's.

Analysts from category 1 will be certified just before peak processing loads in 1975. Analysts from category 2 can be certified after being given specified training as outlined in appendix B. Maintaining proficiency for personnel in all categories will be addressed on an individual basis. The numbers of analysts to be trained from each category and the training and certification schedule are given in section 3.0 of this document.

The approach taken is to train and certify initially individuals who completed the formal LACIE training course and who have been involved in operational analysis activities. Thirty-seven Lockheed Electronics Company, Inc. (LEC) personnel completed the automatic data processing (ADP) course, and 28 LEC personnel completed the image interpretation course. Twenty-eight of the 37 DPA's and 14 of the 28 AI's were directly involved in LACIE Phase IA analysis. Initially, top priority will be placed on certifying qualified candidates from this group of individuals. Certification of other analysts will be completed as required.

2.0 APPROACH

The processing load (i.e., segments per month) is the key factor determining the number of analysts required. The assumed processing load and the number of AI's and DPA's required to process this load are included in appendix A.

In the development of this plan, the following additional assumptions were made:

(1) An average month consists of 22 working days.

(2) An analyst works an average of 19.5 days per month. This factor takes into consideration 10 vacation days per year, 9 holidays, an average of 6 days of sick leave per year, and 104 days for weekends (i.e., 5 work days every 7 days).

(3) Seventy-five percent of all acquisitions are available for processing.

(4) Rework rate is 25 percent for DPA's and 5 percent for AI's.

(5) An AI can process one segment per day.

(6) AI's process all foreign exploratory sites, U.S. exploratory sites, intensive study sites, and 20 percent of the remaining sites in 1975. AI's process mean level adjustment sites starting in April 1975.

(7) A DPA can process at the following rate based on an increase in proficiency with experience:

(a) 2 segments per day through April 1975

(b) 2.5 segments per day in May 1975

(c) 3 segments per day in June 1975

(d) 3.5 segments per day in July 1975

(e) 4 segments per day in August 1975 and all months thereafter

(8) Segment processing curves and tables do not indicate segment backlogs. Segment backlogs are considered contingency modes of operation.

(9) DPA's process all segments.

(10) Sites will be processed using pre-emergence, green, heading, and mature phases.

(11) Contingency needs for AI's* are also indicated for 1976 in the event that signature extension has the following modes of success:

(a) If signature extension is successful, 20 percent of the segments will be interpreted.

(b) If signature extension is moderately succesful, 40 percent of the segments will be interpreted.

(c) If signature extension is unsatisfactory, 100 percent of the segments will be interpreted.

(12) Equipment resources are available for processing any segment load.

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*See contingency plan, section 4.0.

Note: Full consideration must be given to the fact that these assumptions are subject to modification at this time.

(13) Segment loads are based on 1,200 sites for 1975 and 4,800 sites for 1976.

Support personnel are categorized as follows: category 1, primary analysts; category 2, analysts assigned to duties other than LACIE production; category 3, senior technical personnel; and category 4, new hires. For reference, a more thorough description of these categories is given in appendix B.

Personnel from categories 2, 3, and 4 are potential analysts if given appropriate training. Category 1 personnel are the prime analysts, category 2 personnel are the prime backup analysts, category 3 is an additional source for backup analysts, and category 4 is the primary source for replacement due to attrition.

An outline of the AI and DPA training curricula for each of the four categories of personnel is included in appendix B. An outline of the AI and DPA certification plan is given in appendix C. Backup analysts in categories 2 and 3 are currently supporting either TF4 or TF5, and an indication of the location of these analysts is supplied in appendix D.

Prime analysts are currently involved in LACIE production and other related activities. A list of these additional activities is included in appendix E.

Backup analysts in categories 2 and 3 are currently supporting either NASA/Earth Observations Division Branches TF4 or TF5, and an indication of the location of these analysts is supplied in appendix F.

3.0 TRAINING SCHEDULE

Training for LACIE operational readiness has been a continuing task for a large number of on-board analysts; however, predicted segment processing rates indicate that training of additional personnel with varying amounts of operational experience will become necessary.

In appendix A several charts and graphs (figs. A-1 through A-3) that illustrate the number of analysts required to process expected segment loads for the 1975-1976 time period are presented. The number of analysts available in 1975 is indexed to the level dedicated to LACIE operations support in February 1975. For 1976, a projected support level is used as a reference level. Requirements for minor deviations from the index figure (of 1 to 2 analysts) over a short period of time will be handled with the use of overtime. Larger requirements will be satisfied by training nonoperational analysts and/or newly hired personnel.

Figure A-4 in appendix A illustrates that a shortage of category 1 AI's will exist during the period from late March to early July 1975, with a maximum shortage of 13 analysts in June. With utilization of available category 2 analysts (5) and category 3 analysts (4), a four-man equivalent remains to be accounted for by allowing a backlog of segments to accumulate and by utilization of overtime. Training for category 2 analysts should commence by the first week in March, and training for category 3 analysts should commence by the first week in April (see figure 1).

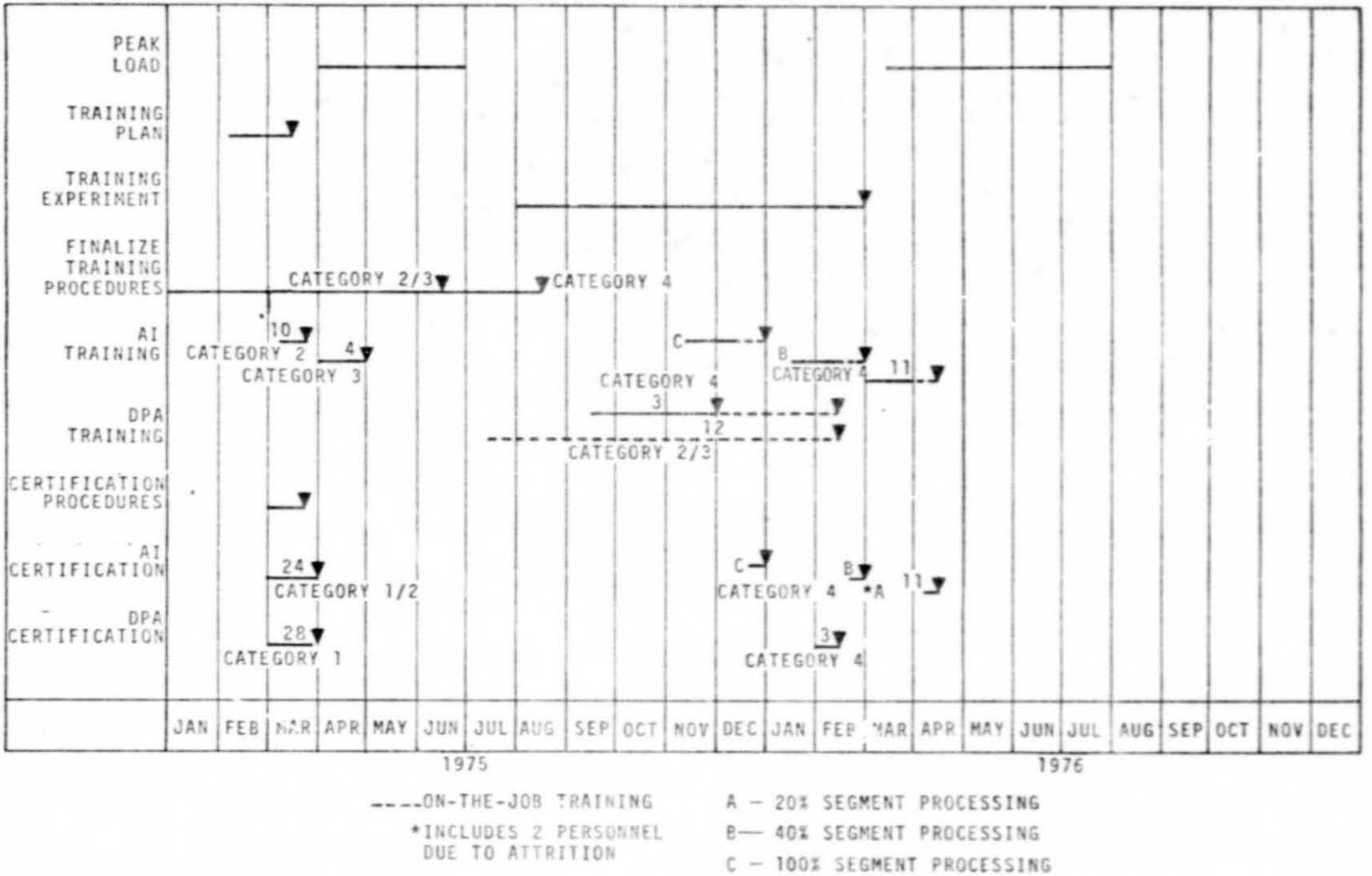

Figure 1.- LACIE training schedule 1975-1976.

Figure A-8 in appendix A illustrates the shortage of AI's that would exist for three different processing rates if they occurred during the 1976 calendar year.

During 1976, using the February 1975 AI personnel level and the 20-percent segment processing value, a shortage of AI's occurs from late March to mid-July with a maximum shortage of eight analysts in May. Although enough category 2 and 3 personnel currently exist to cover this shortage, it cannot reasonably be expected that all these personnel could drop on-going activities for up to 4 months; therefore, some hiring of personnel (4 to 9) would become necessary. Training for new hires would commence by late February 1976. After completion of formal training, on-the-job training will be performed for a minimum of 2 weeks. If segment processing rates for AI's increase to the 40- and 100-percent rates, training for new personnel would commence by mid-January 1976 and mid-November 1975, respectively.

Figure A-6 indicates a possible shortage of DPA's to exist starting late in March 1975. This apparent shortage will be accommodated by allowing a reasonable backlog in segment processing prioritizing the processing of selected segments, analysts working overtime, and minimum scheduling of vacation time for processing personnel.

In 1976, with a staffing level of 30 DPA's, a shortage of 12 DPA's will exist from late March to early July (see figure A-10). The shortage will be alleviated by using category 2 analysts during this peak processing period. An appropriate level of proficiency for these personnel will be maintained to enable them to assist in processing this load. Newly hired personnel should be onboard by September 1975 and should complete 5 weeks of classroom and ERIPS training and additional on-the-job training. Training schedules are shown in figure 1.

Certification of analysts is to take an average of 1 day and will occur after the analysts have finished training and have experience performing in the actual LACIE environment.

4.0 CONTINGENCY TRAINING PLANS

Assuming an attrition rate of 10 percent, it can be expected that two AI's and three DPA's will be hired as replacements and will receive 6 to 14 weeks (respectively) of training prior to certification. The 1975 segment processing rates can be maintained during the training period(s) by allowing a segment backlog and/or overtime. The current operations plan does allow a backlog to accumulate during peak processing periods for lower priority segments. If a larger attrition rate is experienced during peak processing months, various other approaches can be implemented to maintain segment processing rates (e.g., working 7-day weeks and accepting a larger backlog of segments).

An impact of a more critical nature would be an increase in the percentage of segments that the AI's are required to process. The segment loading charts reflect the number of AI's necessary for interpreting 20, 40, and 100 percent of the acquired segments. Interpreting more than 20 percent of the acquired segments has a serious impact on staffing and would require an intensive hiring and training program.

The 1976 man-equivalent level of staffing for DPA's assumes a base level of 30 DPA's dedicated to LACIE operational analysis. Category 2 personnel will be utilized to attain the 30 man-equivalent level. At peakload, category 3 personnel will be needed to assist in processing. If there are not sufficient personnel to handle the peak processing load, several contingency steps could be implemented.

Category 1 personnel could have their workload readjusted so that they devote full time towards processing. The use of overtime could be implemented. If these measures are found to be unacceptable, then new hires (category 4) could be brought in. These personnel would have to be hired before September 1975 to complete training before peak processing loads in 1976 occur.

5.0 CROSS TRAINING EXPERIMENT

A part of the prime management objective as quoted from the LACIE management guidelines of November 11, 1974, is "to assure that the cost-benefit/cost-effectiveness of the LACIE approach in an operational environment is clearly assessed."

The cross training experiment is designed to assess the feasibility of utilizing one individual to perform the functions of both the AI and the DPA. If this proves to be feasible, it could provide the means for more effective manpower utilization.

Two DPA's and two AI's will be identified for cross training. The DPA's will be trained for AI work and the AI's for DPA work according to the category 1 training program presented in appendix B. Specific parts of the curriculum may be omitted if they have been previously completed. After certification, it should be possible to utilize these individuals in either capacity. The capability of the analyst to do both types of analysis on a specific segment will then be evaluated.

This training experiment will be conducted when the workload is low. Consequently, there should be no impact on the load of segments being processed. Schedule for the training experiment is as indicated in figure 1.

APPENDIX A

APPENDIX A

SEGMENT LOADING RATE/MANPOWER REQUIREMENTS

The number of segments processed for LACIE varies in accordance with the crop calendar for wheat and with the number of sites selected. In 1975 and 1976, this places a peak segment load during the summer months and a corresponding lighter load for the remaining months. A chart and corresponding graphs are included in this appendix to reflect this loading.

The following charts and graphs (figs. A-1 through A-10) represent the anticipated segment loading and manpower needs for 1975 and 1976.

MONTH	DPA LOAD	DPA DAILY LOAD*	DPA'S REQUIRED	AI LOAD	AI'S REQUIRED AND DAILY LOAD*
+JAN	17	1	1	23	1
+FEB	70	3	2	132	7
MAR	220	10	6	131	7
APR	996	46	24	398	20
MAY	1052	48	20	512	26
JUNE	1216	55	19	538	27
JULY	861	39	12	341	17
AUG	392	18	5	50	3
SEPT	215	10	3	27	1
OCT	194	9	3	37	2
NOV	28	1	1	27	1
DEC	14	1	1	6	1

+ ACTUAL FIGURES FOR THESE MONTHS
* LOAD PER WORKING DAY

Figure A-1.- AI and DPA segment operations load for 1975.

MONTH	DPA LOAD	DPA* UNIT LOAD	DPA'S REQUIRED	100% PROCESSING	AI'S REQUIRED AND DAILY LOAD*	40% PROCESSING	AI'S REQUIRED AND DAILY LOAD*	20% PROCESSING	AI'S REQUIRED AND DAILY LOAD*
JAN	598	27	8	502	25	201	10	100	5
FEB	598	27	8	502	25	201	10	100	5
MAR	822	37	10	691	35	216	14	138	7
APR	2124	97	27	1784	90	714	36	357	18
MAY	3248	148	41	2728	138	1091	55	546	28
JUNE	3308	150	42	2779	140	1112	56	556	28
JULY	2571	117	32	2159	109	864	44	432	22
AUG	1276	58	16	1072	54	429	22	214	11
SEPT	770	35	10	647	33	259	13	129	7
OCT	1131	51	14	950	48	380	19	190	10
NOV	737	34	9	619	31	248	13	124	6
DEC	621	28	8	521	26	209	11	104	5

* LOAD PER WORKING DAY

Figure A-2. – AI and DPA segment load for 1976.

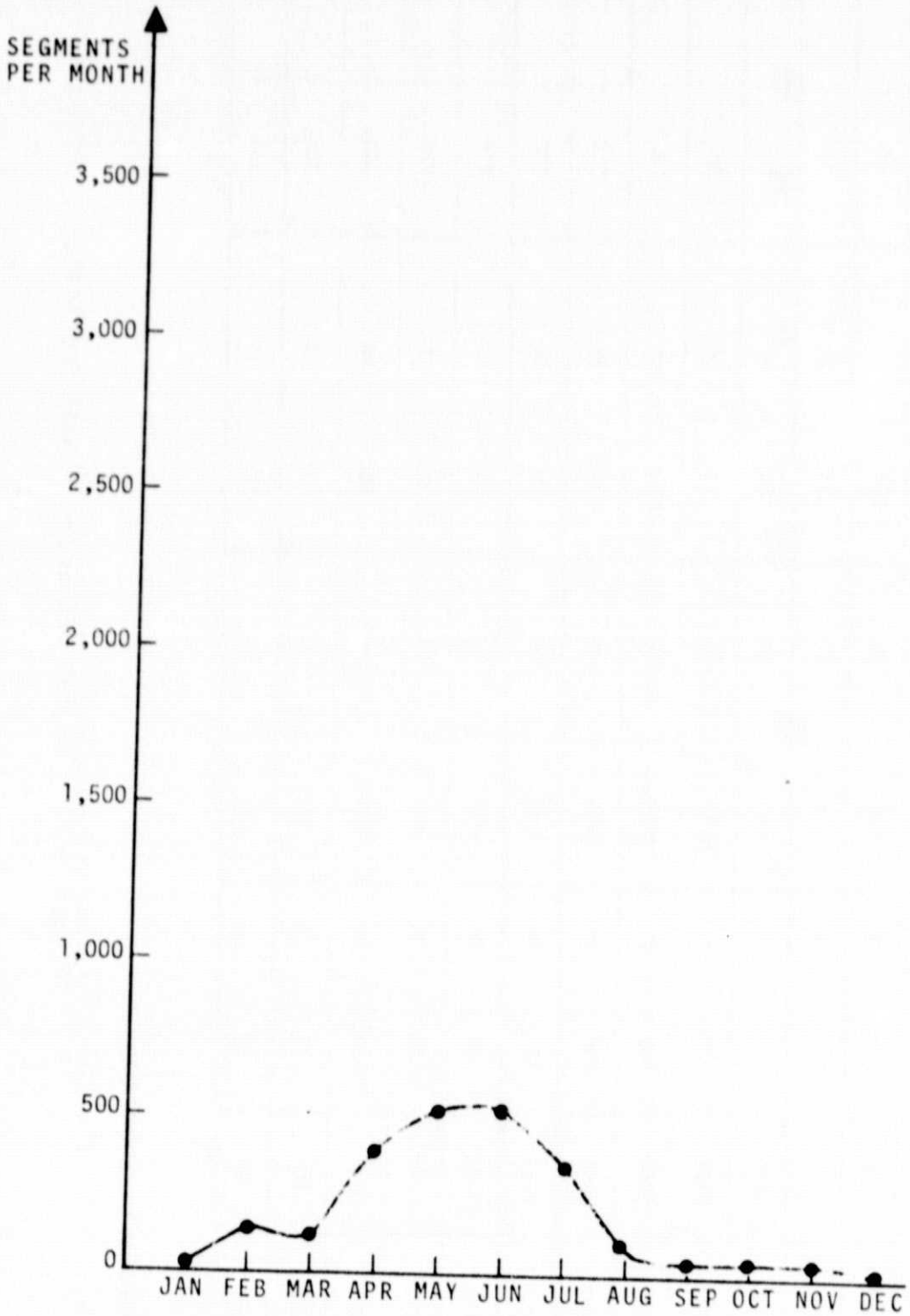

Figure A-3.– AI segment load for 1975.

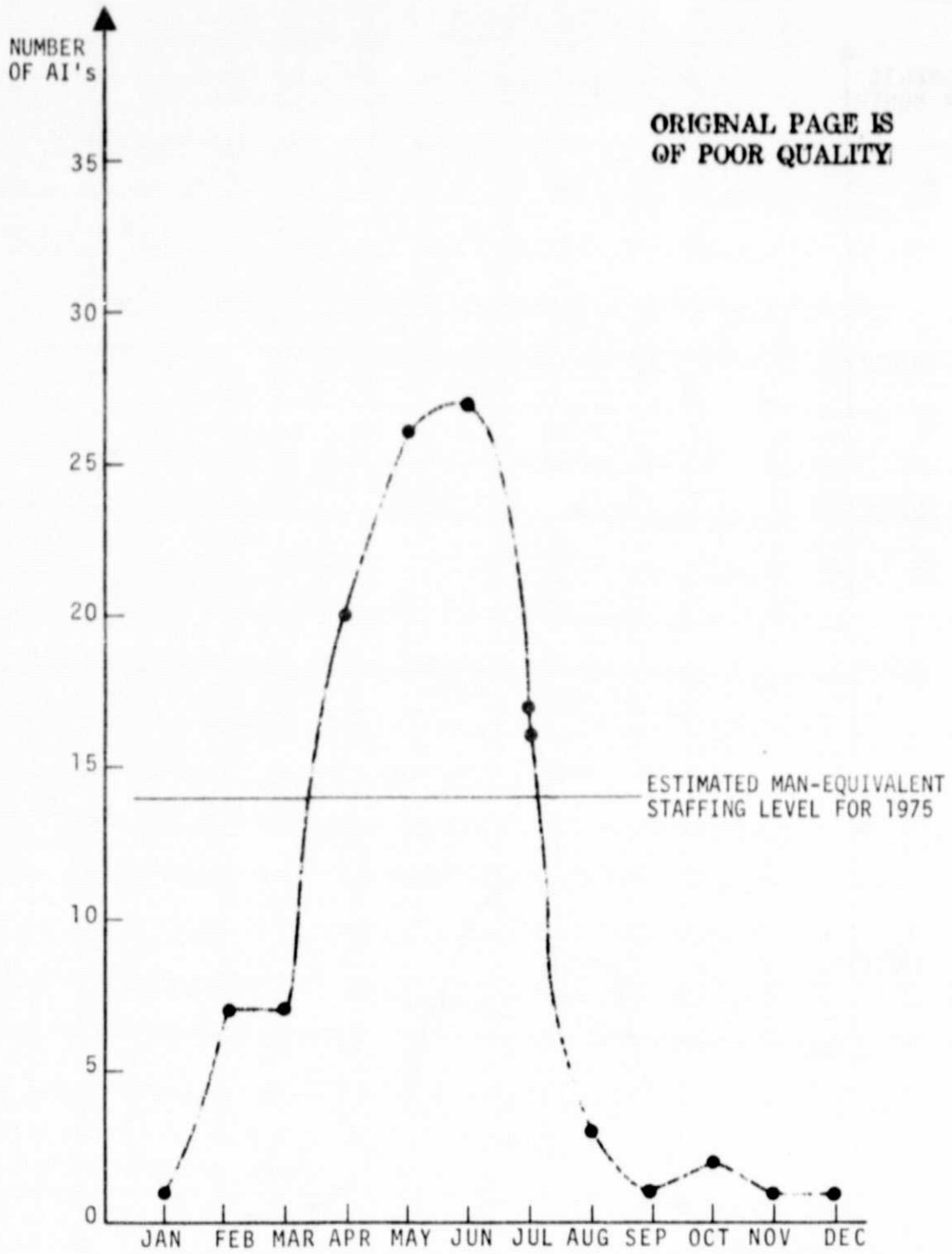

Figure A-4. – Required number of AI's vs time for 1975 segment load.

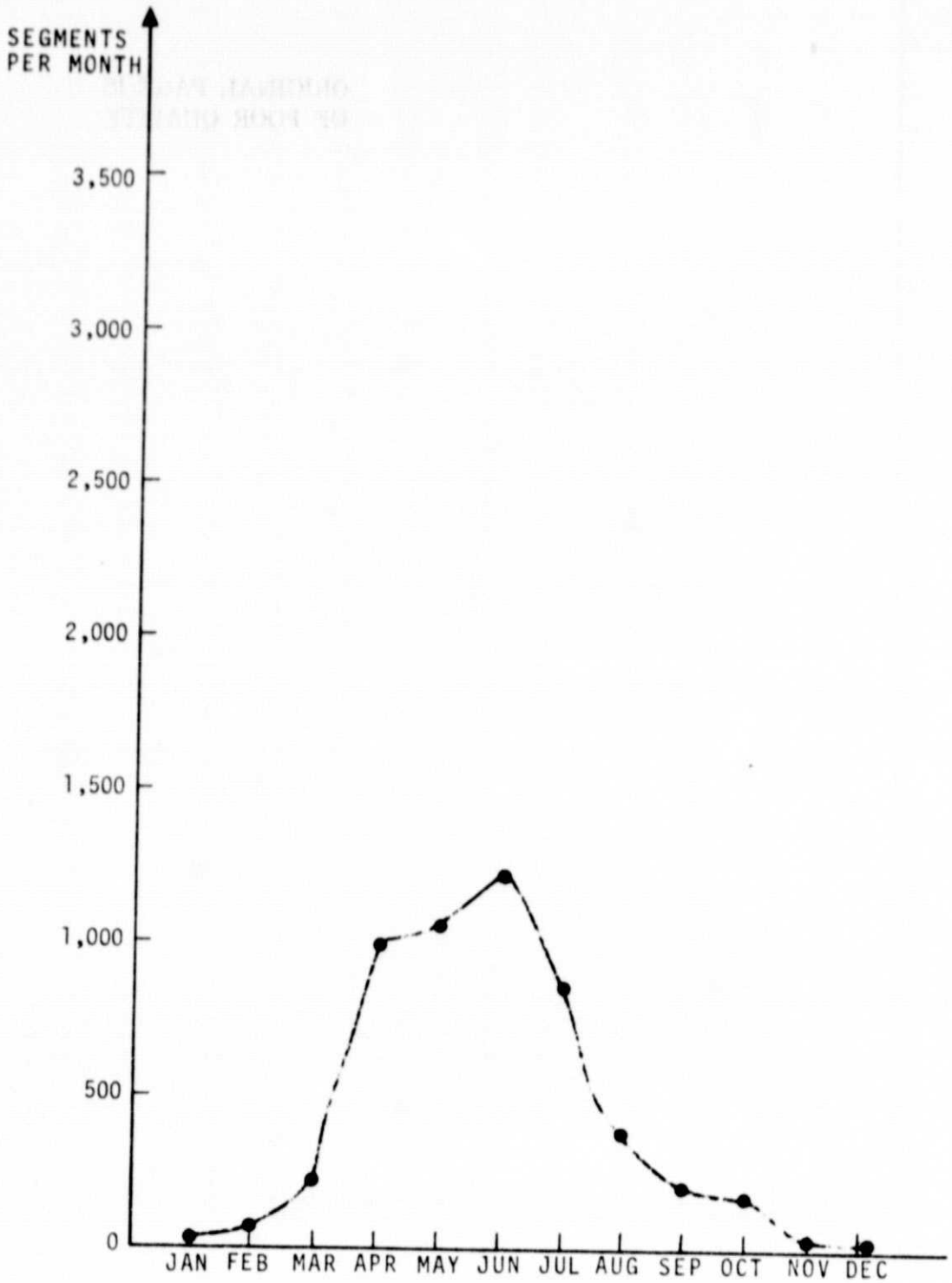

Figure A-5. – DPA segment load for 1975.

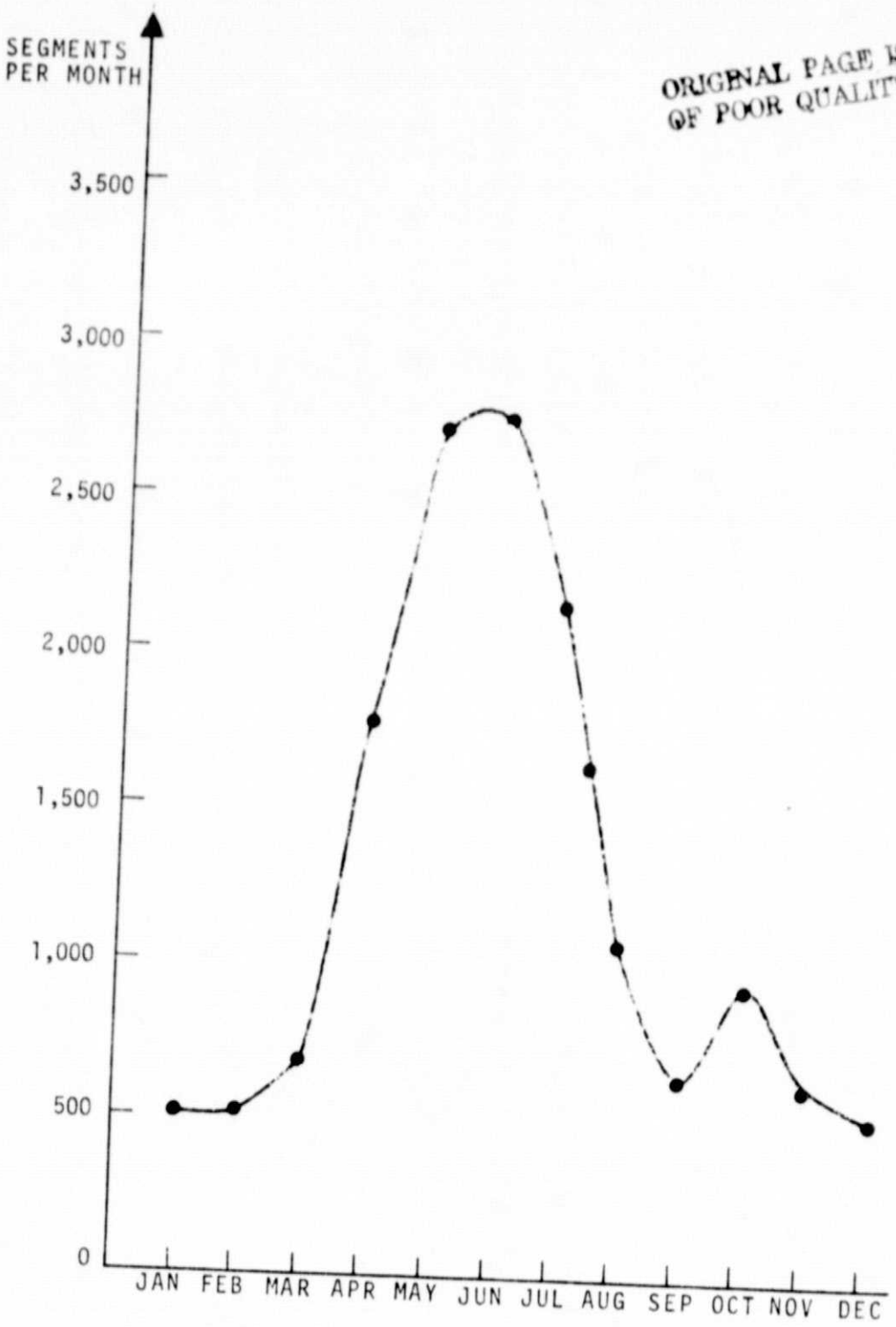

Figure A-7. – AI segment load for 1976.

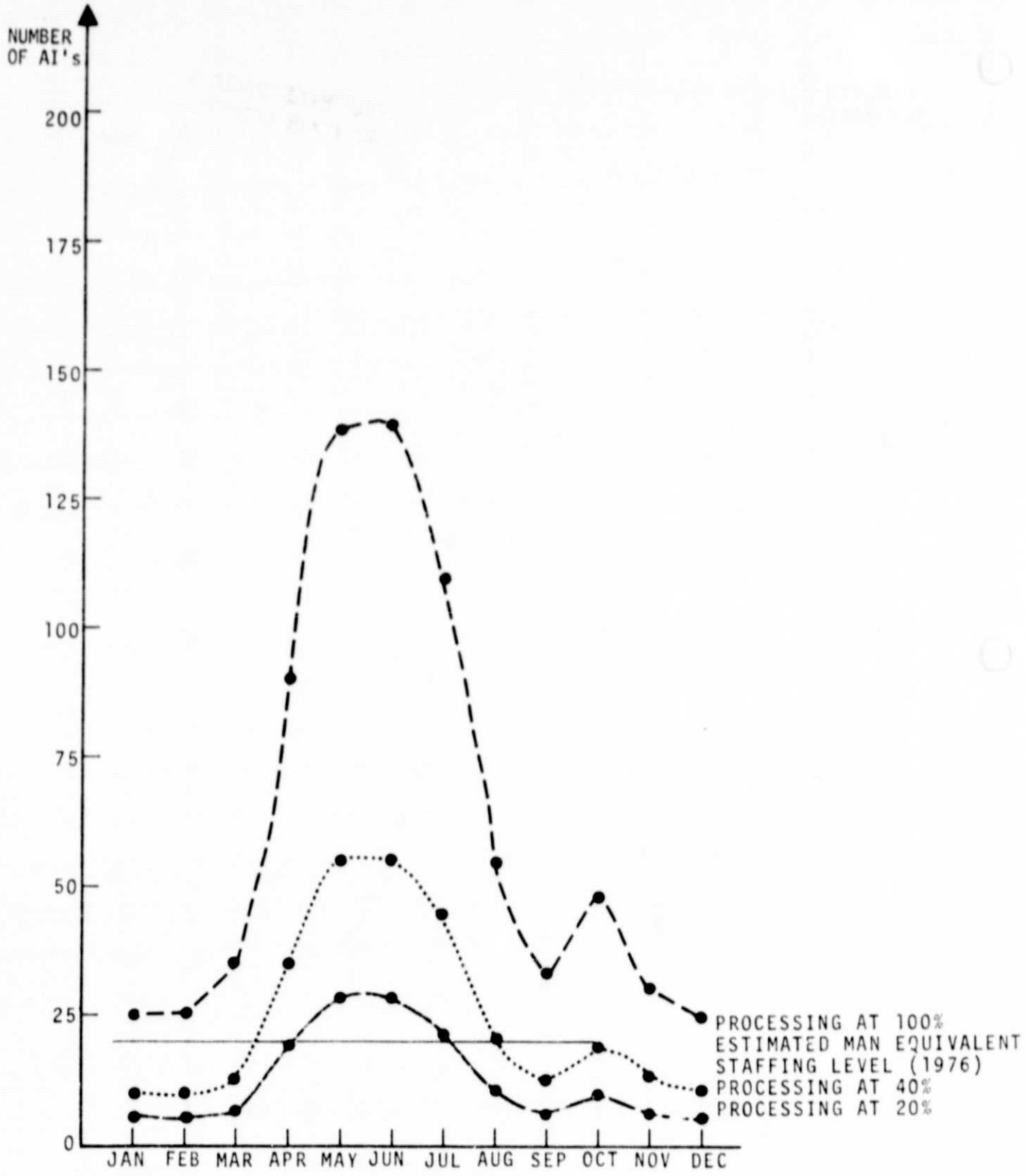

Figure A-8. – Required number of AI's vs time for 1976 segment load.

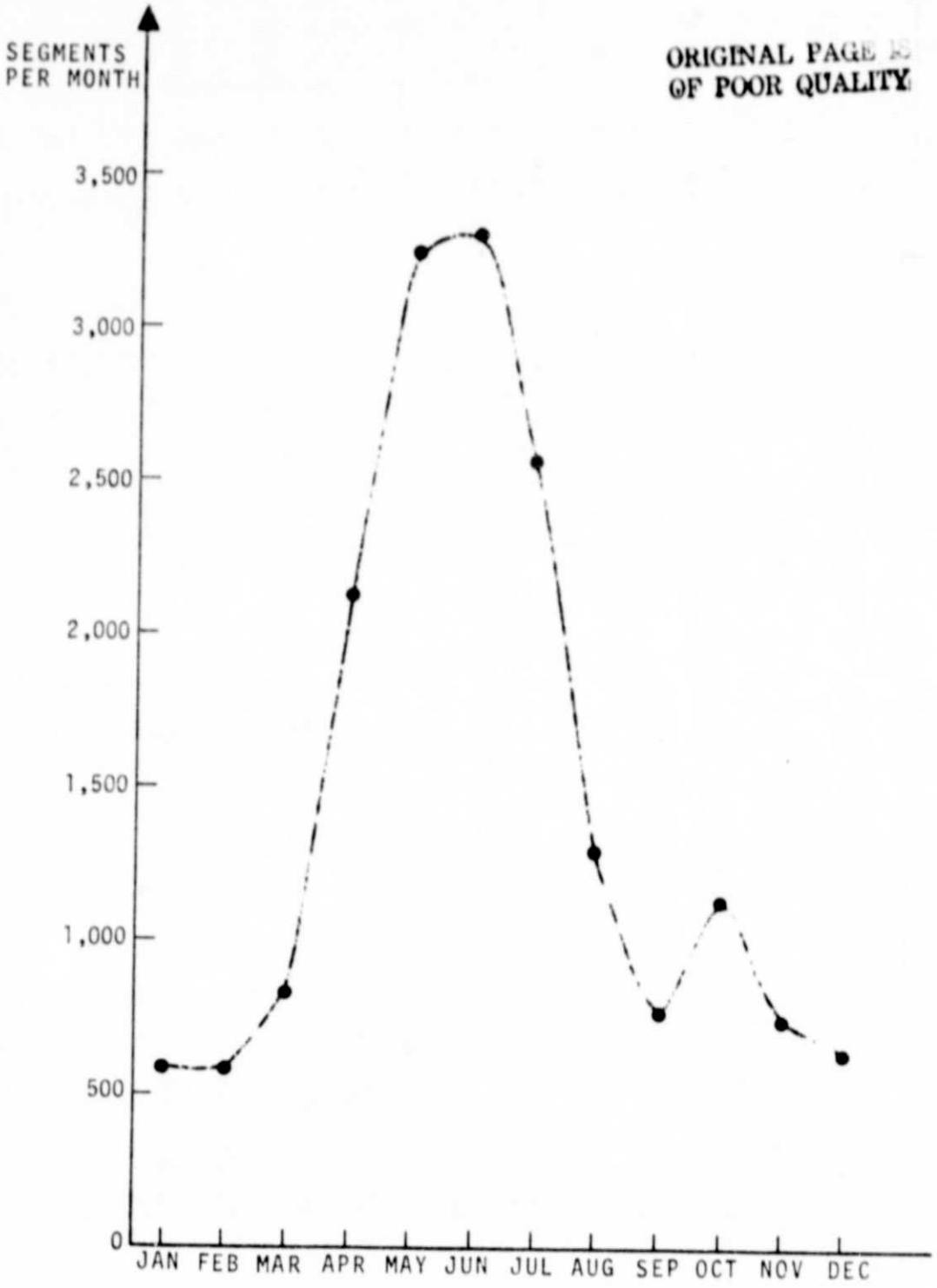

Figure A-9. – DPA segment load for 1976.

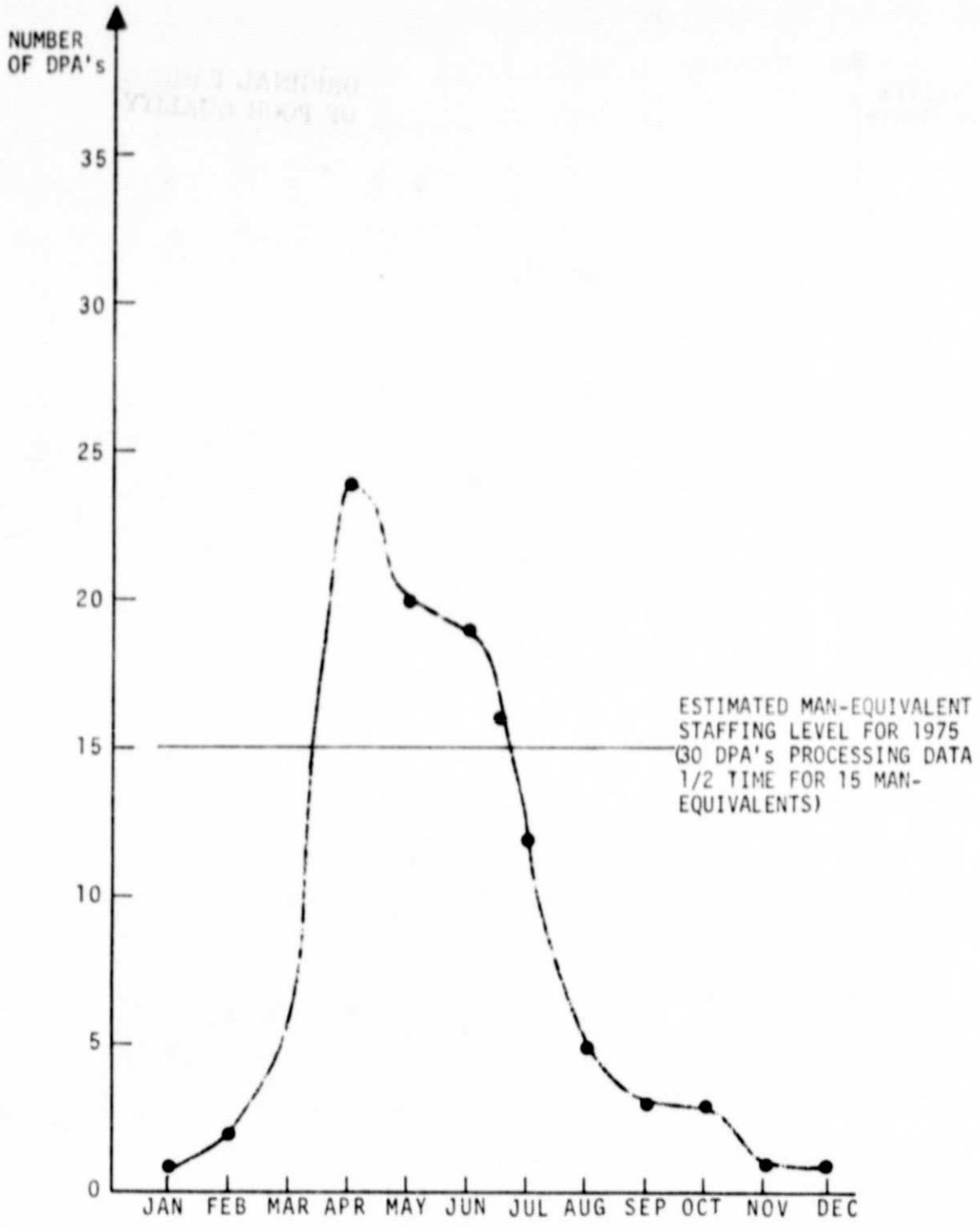

Figure A-6. – Required number of DPA's vs time for 1975 segment load.

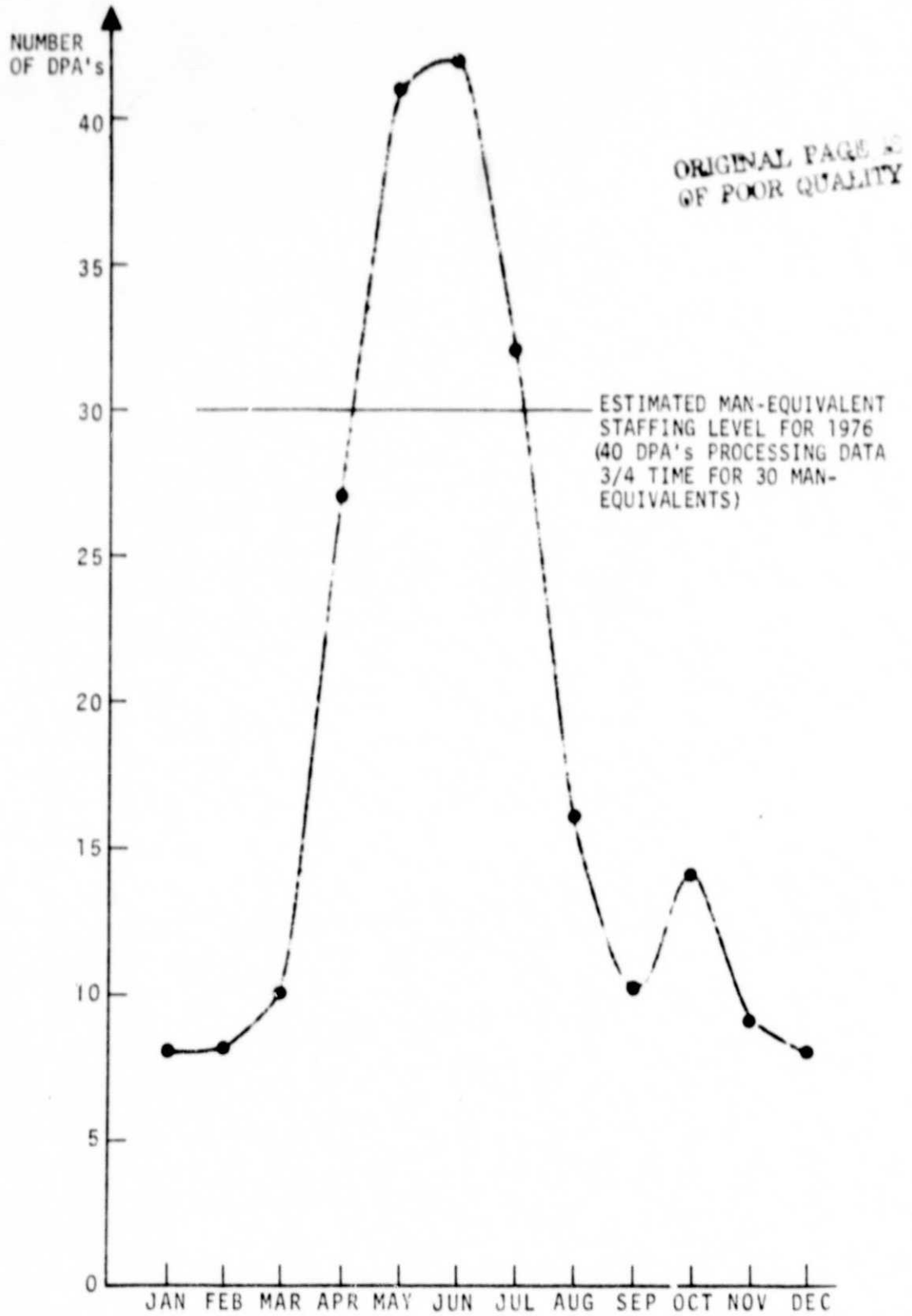

Figure A-10. – Required number of DPA's vs time for 1976 segment load.

APPENDIX B

APPENDIX B

PERSONNEL CATEGORIES AND TRAINING CURRICULA

B.1 PERSONNEL CATEGORIES

Personnel considered available for AI and DPA operational tasks are categorized below for determining the amount of specific training for operations support.

Category 1 – Individuals whose primary duty is LACIE operational analysis and who have minimal other assigned duties.

Category 2 – Personnel who have experience in remote sensing analysis and LACIE operational analysis but whose primary duty is other than LACIE operational analysis.

Category 3 – Senior technical personnel who generally have experience in remote sensing analysis but not necessarily in LACIE operational analysis and who have a primary duty other than LACIE operational analysis.

Category 4 – Newly hired personnel who are generally new college graduates.

B.2 TRAINING REQUIREMENTS

B.2.1 General

The following outlines list the topics required to be covered by analysts prior to LACIE certification. Each

category of AI and DPA onboard will be required to take unfulfilled portions of these courses, while new hires (category 4 personnel) will be required to complete all topics satisfactorily. AI and DPA training course outlines are presented below with the time required to cover all subjects. Portions of the course required for each category of personnel follow the respective outlines.

B.2.2 AI Training Requirements

B.2.2.1 LACIE AI training course outline.– The course outline for AI training is as follows:

Day	Section	Subject
1-2	I	Elements of photointerpretation and electromagnetic radiation
3	II	Atmospheric and sun angle effect; azimuthal variation in directional reflectance
4	III	Image formation with color films
5	IV	Image formation in line scanning systems; multispectral scanning systems; geometric characteristics of line scan systems; introduction to LANDSAT-1
6	V	Tone contrast, edge gradiant, resolution
7	VI	Physiology and cropping practices – small grain
8	VII	Land use interpretation – aircraft, LANDSAT-1
9	VII	Cereal crop identification

Day	Section	Subject
10	IX	Automating the interpretation process
	X	Geography and agricultural applications – the United States
	XI	Geography and agricultural applications – U.S.S.R.
	XII	Geography and agricultural applications – Canada
*	XIII	Geography and agricultural applications – Australia
	XIV	Geography and agricultural applications – Brazil
	XV	Geography and agricultural applications – India
	XVI	Geography and agricultural applications – China
	XVII	Geography and agricultural applications – Argentina
11	XVIII	General LACIE operations
12-15	XIX	Detailed CAMS operations
16-20	XX	Case study
21-30	XXI	LACIE AI on-the-job training
31	XXII	Certification case study

*Optional. One day each.

B.2.2.2 AI training requirements for each category.- Training requirements for each category of AI's are as follows:

Training for category 1 personnel consists of briefings on new procedures and equipment as required and participation in the certification case study (AI course outline, sections XXI and XXII).

Training for category 2 personnel consists of 1-week training on the job, briefings on new procedures and equipment, and participation in the certification case study (AI course outline, sections XXI and XXII).

Training for category 3 personnel consists of participation in a 1-week case study, 2 weeks of training on the job, and participation in the certification case study (AI course outline, sections XX, XXI, and XXII).

Training for category 4 personnel consists of 3 weeks of course material, a 1-week case study, 2 weeks of on-the-job training, and participation in the certification case study (AI course outline, sections I through XXII).

B.3 DPA TRAINING REQUIREMENTS

B.3.1 LACIE DPA Training Course Outline

The course outline for DPA training is as follows:

Day	Section	Subject
1-3	I	Introduction to remote sensing
	II	Spectral signature of crops

Day	Section	Subject
	III	Basic probability and statistics
4	IV	Clustering and training the classifier
5	V	Feature selection
6	VI	Classification and temporal analysis
7-13	VII	Training on the Earth Resources Interactive Processing System (ERIPS)
14-24	VIII	LACIE overview
	IX	CAMS overview, CAMS requirements and procedures
25-50	X	On-the-job training with experienced analyst
51-100	XI	Submittal and evaluation of LACIE runs with the evaluation group
101	XII	Certification case study

B.3.2 DPA Training Requirements for Each Category

Training for category 1 personnel consists of briefings on new procedures and equipment as required and participation in a certification case study.

Training requirements for categories 2 and 3 personnel for operational proficiency consist of briefings on changes on the ERIPS, a LACIE CAMS overview, on-the-job training, and participation in a certification case study (DPA course outline, sections VIII, IX, X, XI, XII).

Training for category 4 personnel consists of 5 weeks of classroom and ERIPS training, on-the-job training, and participation in a certification case study.

APPENDIX C

APPENDIX C

CERTIFICATION PLAN OUTLINE

C. 1 PURPOSE

The purpose of certification of potential AI's and DPA's is to ensure the successful performance of LACIE daily operational analysis.

C.2 SCOPE

Present plans indicate the desirability to certify 28 DPA's and 24 AI's (eligible personnel) early in 1975. These numbers will increase to at least 40 DPA's and 28 AI's for 1976. Those to be initially certified will be personnel who have successfully completed the LACIE training course. In addition, it will be necessary to certify backup senior analysts with varying amounts of operations experience and eventually replacements due to ordinary attrition. The plan for certification must accommodate all these types of personnel. Management will consider analysts for 1975 certification before April 1, 1975. Initial certification will be for Phase I of the LACIE system. Subsequent certifications will be for the system version operational at that time and will be accomplished with updated procedures. However, each analyst will be certified only once.

C.3 TECHNICAL APPROACH

The attached flow diagram (fig. C-1) summarizes the steps leading to LACIE certification. Personnel may be

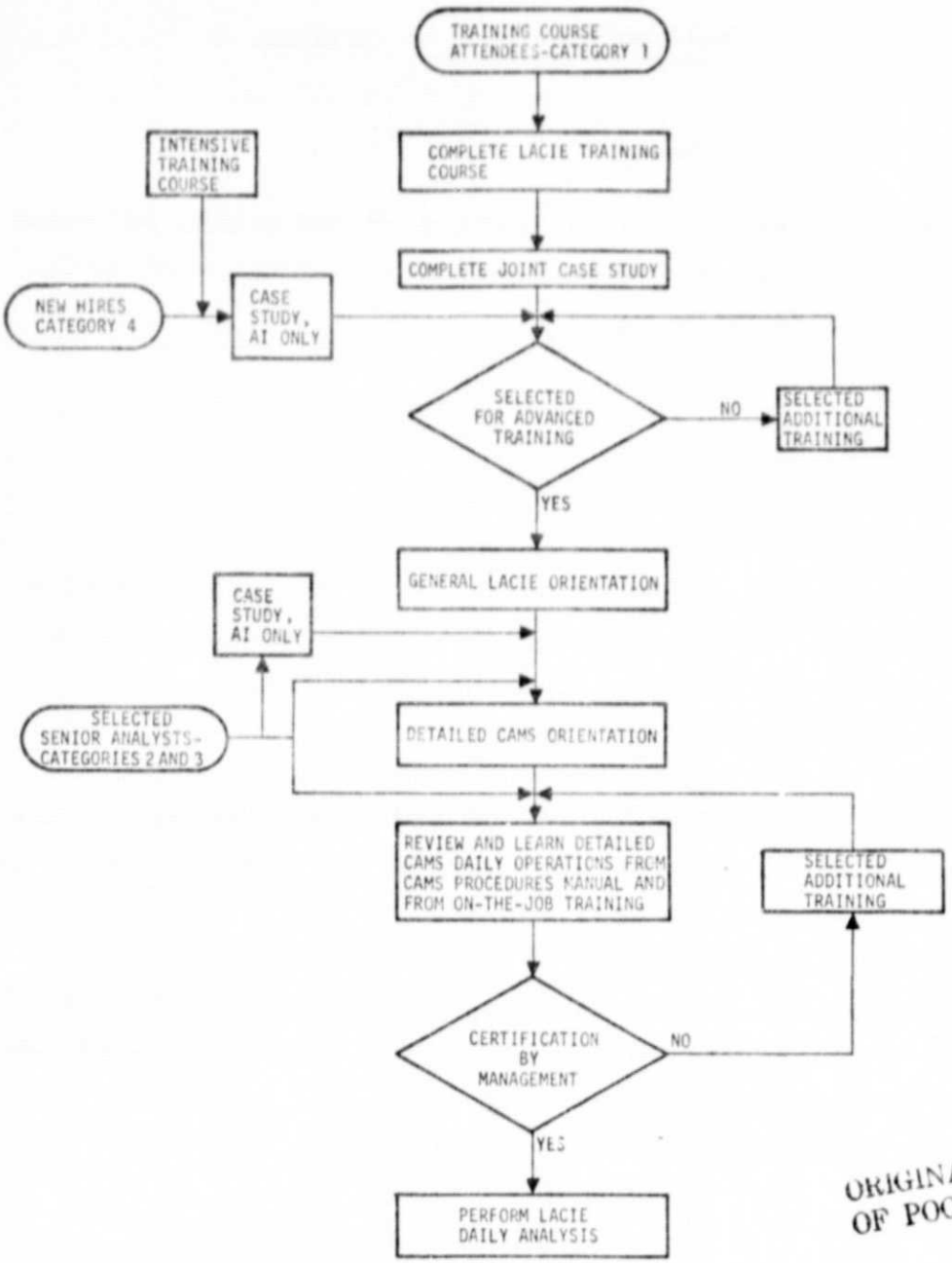

Figure C-1.— AI and DPA certification procedures.

entered at several levels to accommodate differing backgrounds and LACIE requirements. For example, new hires, depending on their backgrounds, may either be selected for immediate advanced training or for selected additional training. The time factor for certification of additional personnel beyond the original 28 DPA's and 24 AI's may dictate that condensed versions of each step in the certification plan should be utilized.

For certification each AI is required to

(1) Have a general understanding of remote sensing principles and worldwide agricultural practices.

(2) Have a basic understanding of the biological growth phases of wheat (plus associated crops) and the resultant signature as reproduced on single band and multiband imagery.

(3) Be able to identify wheat fields using temporal LANDSAT imagery products and associated ancillary data (e.g., nistorical crop summaries and climatological reports).

(4) Have a general understanding of the LACIE program and a specific knowledge of LACIE/CAMS procedures related to AI operations.

(5) Be able to efficiently interpret and process a LACIE segment as outlined in the CAMS detailed procedures document under image interpretation procedures.

Requirements 1 through 3 will be evaluated during the training program, during the subsequent case study(studies),

and during the on-the-job training period.

Requirement 4 will be evaluated during the on-the-job training period.

Requirement 5 will be evaluated during a 1-day certification case study before April 1, 1975 (for the prime analysts).

During the certification case study, two senior AI specialists will evaluate the ability of each candidate to follow established procedures and to perform the required functions associated with the interpretation of a segment.

LACIE/CAMS management will review certification case study results and all previously collected evaluation material before making the decision to certify or reconsider the AI for certification with additional training or to assign the AI to operational support.

Certification for the DPA's will be dependent on the potential analyst's past achievement, current ability, proficiency with CAMS processing procedures, and LACIE Phase I operations. This will be accomplished by the LACIE/CAMS management, interfacing with the evaluation committee to evaluate the analyst's operational ability.

The following factors will be considered for DPA certification:

- The ability of the analyst to execute the CAMS

procedures on ERIPS correctly and efficiently.

- The ability of the analyst to interpret and evaluate the data processing results.
- The analyst's overall understanding of the CAMS and and LACIE Phase I operations.

C.4 DISCUSSION

AI and DPA personnel who completed the LACIE training course and who were involved in LACIE Phase I operations are the prime candidates for certification. Other personnel who either completed the training course or were involved in LACIE Phase I operations may still be considered candidates on an "as needed" basis. The prime candidates are 28 DPA's and 24 AI's. LACIE/CAMS management will determine who will be selected for advanced training as preparation for certification. As attrition produces the need to certify replacements, the additional training necessary for replacements before selection for advanced training will be determined. The general LACIE orientation and the detailed CAMS orientation will be as complete as resources allow. Subsequently, orientations for replacement personnel may be condensed, with emphasis placed in on-the-job training.

Initially, a 1-day detailed operations procedure based on the LACIE Phase I CAMS procedures manual will be developed for the AI's. This 1-day procedure will be the certification case study.

Recommendations for certification of DPA's will be initiated by the LACIE/CAMS management. It will be assumed

that after certification each analyst will have the ability to adapt to LACIE systems revisions. Proficiency will be maintained primarily by on-the-job training.

APPENDIX D

APPENDIX D

LOCATION/AVAILABILITY OF BACKUP ANALYSTS

The following tabulations reflect the number of support personnel in each category and indicate which branch of the Earth Observations Division of the National Aeronautics and Space Administration they are currently supporting. It is assumed that they will be available as required to support LACIE operational analysis.

DPA's	TF4	TF5	TF4 and TF5
Category 1	28	0	28
Category 2	5	8	13
Category 3	4	7	11
	37	15	52

AI's			
Category 1	14	0	14
Category 2	10	0	10
Category 3	2	2	4
	26	2	28

APPENDIX E

APPENDIX E

WORK PERFORMED BY ANALYSTS WHEN PROCESSING RATE IS LOW

Planned segment acquisition rates for 1975/1976 reach a peak during the spring and early summer and are at a minimum over the winter months. To meet expected maximum segment loading during 1975, category 2 personnel will be drawn into operational status. Overtime will be used if necessary to eliminate unacceptable segment backlogs. Because preparation for operational analysis represents a considerable portion of each AI's and DPA's responsibilities, those times of the year when the segment loading is down does not indicate a proportional decrease in the workload. In addition, numerous projects related to improving operational efficiency are currently being conducted or are anticipated for the coming year.

The following is a partial listing of the areas of responsibility of analysts when they are not working in production:

I. DPA/AI Procedures Development and Verification

To develop, document, and verify procedures to govern the segment analysis.

II. Evaluation and Rework Procedures Development

To develop, document, and verify evaluation and rework procedures to encompass guidelines for spotting possible analysis problems, rework procedures, and criteria for determining the level of acceptability of analysis.

III. Internal Flow Control Operations

The orientation of analysts to the tasks of data recording and transmittal, coordination of interfaces within CAMS activities, and the maintenance of adequate records to enable management to evaluate operational efficiency.

IV. Accuracy Assessment

The development and implementation of procedures to compare ground truth results to actual segment estimates.

V. CAMS Signature Extension Procedures Development

The development and implementation of signature extension partitioning procedures.

VI. LACIE Training and Coordination

The development and implementation of training programs to maintain and update the skills of LACIE personnel.

VII. Preparation for Segmert Processing

The collection and reviewing of regional agricultural data associated with anticipated segment analysis.

APPENDIX F

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RESOURCES REQUIRED

Training Personnel

The tasks are to develop and document a training plan, develop and document training course material, develop and document certification procedures, and conduct training/ maintenance of skills. The manpower requirements include full-time personnel (1 AI and 2 DPA's),and instructor support from TF4 as required.

Equipment for AI's

Essentially no additional requirement for equipment resources exists. AI training requires the use of personally assigned interpretation equipment and ADP equipment (e.g., a remote sensing terminal and measurement units) which will be utilized only during on-the-job training.

Equipment for DPA's

Additional computer time for training DPA's is required. Approximately 52 hours are required on an ERIPS terminal for each trainee. Manuals and documents currently being used will also be required. On-the-job training and certification will be performed utilizing time scheduled for production.