LARS Information Note 110475

LARS Computational Facility
Users Guide

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The Laboratory for Applications of Remote Sensing

Purdue University, West Lafayette, Indiana

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ABSTRACT

The LARS Computational Facility User's Guide is designed to document and incorporate all the basic information one needs in order to gain access to the machine and to use the equipment. Topics covered include a description of the LARS Computer services (both hardware and software), administrative procedures, documentation available, procedures for operating terminals and/or submitting jobs, and notes for programming.

*The facility described in this document was established in February 1975 as a self-supporting enterprise of Purdue University. The author is the Manager of Basic Systems in the computational facility and developed the original Purdue/LARS Computers Users Guide Information Note 011074 which is superseded by this document.
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LARS COMPUTATIONAL FACILITY COMPUTER USER'S GUIDE

1.0 INTRODUCTION AND PROCEDURES

1.1 LARS COMPUTATIONAL FACILITY PURPOSE AND PHILOSOPHY OF USE

The LARS computational facility exists to supply specialized and unique computation services to the sponsored projects of the Purdue University Laboratory for Applications of Remote Sensing.

The facility operates with the following objectives:

1. The facility must operate on a no-profit, no-loss basis in such a way as to provide LARS research projects with necessary computer services at a minimum financial risk to Purdue University.
2. The facility must simultaneously provide services that encourage the LARS research community to support the services with their research dollars through a rate structure that meets their needs by offering uncomplicated alternatives from which they may plan the expenditure of their resources.

A user of LARS Computational Facility products or services will typically be an analyst doing research on or applications using Remote Sensing concepts. Establishing a computer ID gives a user access to LARSYS and to a data library of multispectral image data, as well as normal access to a general purpose computer. The LARSYS multispectral image processing system is a fully documented software system for advanced research, development, and application of Remote Sensing concepts. Implementation of LARSYS on a general purpose computer with time-sharing and remote terminal capabilities increases the availability of the data and processing capabilities to the user.

Facilities are available with as few restrictions as possible consistent with maintaining efficient utilization of resources and fairness to all users. The few regulations necessary are detailed in this guide.

1.2 WHAT PRODUCTS AND SERVICES ARE AVAILABLE

The products and services provided by the LARS Computational Facility fall into three basic types:

1. Computer Services
2. Reformatting Services
3. LARSYS Products and Special Products

Appendix A contains a list of the current services, and the cost of each. The sections below are intended to

provide a more detailed description of each service or product.

1.2.1. COMPUTER SERVICES. The services in this group involve direct usage of the computer system.

Computer Services - CPU Time. This rate covers usage of the 360/67 Central Processing Unit (CPU). It includes access to the CPU, to CP, CMS, LARSYS, and other software to run on the CPU. It also includes personnel support in such areas as processing ID requests, accounting for system usage, managing disk space, maintaining documentation, and providing help or assistance on problems related to using the system or to programming. The basic form of computer usage covered by this rate is access to the system in batch mode.

Terminal System. This is an additional rate for CPU time if the CPU time was used in interactive mode (i.e. from a terminal). Note that it is not a charge on terminal connect time. In other words, users of the system in interactive mode pay both the CPU time rate and the terminal system rate for the CPU time they use. Users accessing the system in interactive mode receive all the basic benefits provided as a result of the CPU time charge discussed above. In addition, they receive additional benefits such as improved or immediate turnaround for jobs and higher priority on tape requests. The terminal system provides convenience and conversational ability which improves the processing environment for many users. To provide such benefits requires additional hardware and operations staff, which are paid for by the terminal rate.

Digital Display Time. This rate is for time the display is attached and dedicated to a user. The display is a special-purpose device attached to the computer which displays grey level images on a high resolution television monitor. Image representations of digital data, such as satellite-collected remote sensing data, can be displayed and manipulated - both before and after processing. Images can be photographed using the associated photocopy unit to produce hard-copy black-and-white or synthesized color images. Using the digital display can provide a qualitative analysis to support results obtained from a quantitative analysis of the digital data. It also provides a convenient method for monitoring analysis procedures by providing an easy means of displaying the whole or any portion of a frame of data. The digital display rate covers the cost of equipment maintenance, camera system costs, digital display personnel and other support costs.

7-Track Tape Drive Time. This rate is for time the 7-track tape drive is attached and dedicated to a user. The 7-track

tape system is composed of a special purpose tape unit that can handle only 7-track tapes. It is normally utilized as an input device for the production of a standard 9-track tape as output.

Disk Storage Space. Disk storage space provides facilities for the online storage of data, programs or procedures for an extended period of time. It allows entering, modifying, storing, or recalling data using the edit facilities in the time-sharing operating system. Storage space may be requested for each ID established or may be requested at a later date. The basic unit is established as one cylinder of storage for one month of its usage.

1.2.2. REFORMATTING SERVICES. The services in this group are of two types: standard reformatting products which constitute the first seven elements of the list and custom reformatting services which are described in the last item in the list.

Table Digitizer. The table digitizer is a special device for producing digital data coordinates from a photograph, topographical map, or chart with a resolution of 50, 100, or 200 units per inch. The device outputs the digital data onto punched cards. This allows pictorial or image data to be translated into a form usable as computer input. Since the device is owned by the Purdue Civil Engineering Department, the rate is derived to recharge the cost of using the device.

A/D Converter. The analog-to-digital conversion system is a set of special equipment used to produce digital computer data from continuous analog data signals such as those data collected by EXOTECH or other non-digital output scanner systems. Converted analog data is recorded on a 7-track digital tape, which can then be input to the computer system. The A/D converter charge is based on the time required to read the analog tape and produce the digital tape as output.

LANDSAT Reformatting. A LANDSAT reformatting job consists of producing data acceptable as input to the LARSYS analysis software from a frame (or portion) of LANDSAT data. The resulting data "run" (on magnetic tape) is then properly labeled and placed in the LARS tape library as a permanent data file for future analysis.

Geometric Correction. The input for a geometric correction job consists of all or part of a LARSYS formatted data tape which was produced as a result of a LANDSAT reformatting job. The output produced is another LARSYS formatted data tape, having data geometrically corrected for image distortions due to the earth's rotation and the sampling

aspect. The image is also rotated to North orientaion to compensate for the tilt of the satellite orbit, and it is rescaled for line printer aspect at a scale of 1 to 24,000. The rate for geometric correction is based on a fixed charge for each frame or portion of a frame, plus an additional charge for each million points of data involved in the correction.

Image Registration. An image registration job consists of merging two LARSYS data runs containing data over the same ground area, collected at different times. The same scene element (example: road crossing) will not generally be found at the same data coordinates in the two input runs. The registration process moves picture elements of the second run such that the same scene elements of both runs have the same data address. Thus, the second run or picture is stretched, compressed and/or rotated such that it is brought into registration with the first run. The resulting data set makes possible the simultaneous analysis of two runs thus allowing temporal, change detection and other analysis applications. The rate for image registration is based on a fixed charge for each run produced, plus an additional charge for each million points of data involved in the corrections.

EXOTECH Reformatting. The LARS EXOTECH Model 20c Spectroradiometer is a field multispectral data gathering device, which produces relatively small amounts of high quality data. This data is used to enhance analysis of multispectral image data in the areas of calibration and detailed spectral characteristics. An EXOTECH reformatting job consists of taking the instrument raw data tape (in analog form) and producing a digitized form of the data. This data is then input to the computer, processed and stored in the computer data bank as a run.

LARSYS Reformatting. A LARSYS reformatting job consists of accepting as input a LARSYS compatible data run (usually not produced at the LARS Computer or at the LARS Computational Facility) and entering it into the LARS multispectral image data library. Generally some editing or small scale reformatting is performed in this process.

Custom Data Reformatting Services. Custom data reformatting services refers to a class of services whose products are infrequently requested or have unique requirements. Since these services are not normal products, they are provided in response to special user requests. The charges for these custom products are made on a (CPU) time and (personnel) materials basis as rated LARSYS products. Current examples of this custom form of reformatting include frame connections, genruns and fixruns.

1.2.3. LARSYS PRODUCTS AND SPECIAL PRODUCTS. The products in this group include time and materials rates for personnel and expendable stores items, as well as miscellaneous products.

Staff Time. Staff time is classified as one of six categories: professional staff, professional assistant, technical assistant, service staff, clerical staff and student. Staff time is available on an hourly basis to provide service for relativly small time durations. Large requests for personnel time will normally be handled by assigning the staff member to a project for some percentage of his time. The rates are derived from the average salaries of each of the six categories of personnel, plus the fringe benefits and cost of computational facility supplies and expenses needed to support the various categories. Common services provided by staff members include:

A. Professional Staff - Handle creative and innovative aspects of project planning and management in consulting with program leaders and other researchers.
B. Professional Assistant - Handle project planning, procedural analysis, high level programming and similar services.
C. Technical Assistant - Handle programming, documentation, limited project planning and procedural services.
D. Service Staff - Handle routine technical and service activities such as graphics, editing, photography and other similar services.
E. Clerical Staff - Handle typing, keypunching, collating and other similar clerical activities.
F. Student Staff - Handle routine programming and documentation services.

Digital Tapes. Digital magnetic tapes are resold to users at cost. The tapes are assigned numbers and storage is provided in the LARS computer room. The computer center staff will assure that each tape contains identification information consisting of tape number, the person responsible for the tape and a list of computer ID's authorized to write on the tape.

Polaroid Film. Polaroid film is purchased in bulk quantity and sold at cost to users of the digital display. Film may be obtained from the Digital Display Technical Assistant or Senior Computer Operator on duty. Black-and-white film, color film, and positive-negative film for greater detail are available.

Custom Digital Display Photograph. A custom digital display

photo job consists of producing imagery from any LARSYS formatted digital data. Output is a standard photographic product - 35 mm film (Plus-X black-and-white slides or Ektachrome-X color slides) or Polaroid film (black-and-white, color, or positive-negative). The image can be produced as a single exposure photo or a color composite representation of multiple channels of data. The rate for this product is a basic rate or set-up fee for consulting and arranging the job, plus a rate for each frame or portion of a data frame, plus a rate for each satisfactory picture produced.

LARSYS User's Manual. The LARSYS User's Manual is a three-volume comprehensive description of the LARSYS software system and the processors available within. It describes how the processor functions are used and controlled. The User's Manual provides a good working knowledge of the LARSYS software system for the LARSYS user, analyst or programmer. The price for the User's Manual is based on a fixed price for processing an order plus an additional charge for each of one or more copies placed in that order.

LARSYS Documentation. The LARSYS documentation package contains materials necessary to the installation of LARSYS Version 3.1 software on a purchaser's computer. The package consists of a copy of the LARSYS User's Manual, LARSYS System Manual, LARSYS Program Abstracts, LARSYS Test Procedures Manual, and three tapes containing LARSYS source code. The LARSYS System Manual contains detailed information on the hardware and software framework of the system, organization of data files, and techniques for implementing the system. It is written for programmers and analysts involved in installation and maintenance of the system.

LARSYS Version 3.1 Update. The LARSYS 3.1 update package consists of replacement pages necessary to update the original LARSYS Version 3.0 Documentation Package to the current Version 3.1. The update also includes three magnetic tapes containing LARSYS Version 3.1 source code.

LARSYS Educational Package. The LARSYS Educational Package is a set of instructional materials that was developed to train people to analyze remotely sensed multispectral data using LARSYS. The package is designed to be used by an individual student aided by an on-site LARSYS expert acting as instructor/consultant. It is designed to allow the student to work at his own rate, along with his other duties. The package also contains a site library consisting of the LARSYS User's Manual, selected LARS Information Notes, and two analysis case studies. The package includes 25 sets of student notes and five sets of instructors notes.

Student and Instructors Notes. A package of Student and Instructors Notes contains 25 sets of student notes and five sets of instructors notes to be used with the LARSYS Educational Package. These notes are expendable and are designed to be left with the individual as reference material.

Student Notes. This is a single set of Student Notes to be used with the LARSYS Educational Package.

LARSYS Program Education. The LARSYS Education Course is designed to give an in-depth study of how LARSYS is programmed. Its structure is flexible in length and content and its objectives are to meet the needs of the student. The objective of the student may be to install LARSYS on a computer, to modify an existing LARSYS system, or any other application where a highly detailed knowledge of the structure of LARSYS is needed. The rate consists of a fixed charge for administering a course plus an additional charge for each week of its duration.

1.3 COMPUTER STAFF (WHO TO TALK TO)

The primary contact within the LARS Computational Facility for computer-related matters for LARS personnel should be the systems programmer, Jeanne Etheridge (phone 228). It is her responsibility to either take care of computer-related problems, LARSYS problems, programming questions or problems, or administrative tasks (ID assignment, accounting reports, tape assignments, etc.), or to refer them to other members of the staff when necessary or appropriate. If she is unavailable, the secondary contact should be Howard Grams (phone 224).

Although Jeanne is designated as the primary contact, this should not be taken to mean that a user cannot contact any other staff member on a specific subject - quite the contrary. The following table lists other full-time computational facility personnel and their areas of responsibility:

LARS Deputy Director	Terry Phillips	Phone 263. Terry has overall responsibility for the general administration of the computational facility.
Computational Facility Manager	Royal Sand	Phone 222. Royal has responsibility for administration and operation of the computer systems.

Data Reformatting Manager	Dave Freeman	Phone 268. Dave's group is responsible for all reformatting products, standard and custom-made as the need requires.
Applications Systems Manager	Bill Simmons	Phone 224. Bill's group is responsible for support of LARSYS, digital display, and other applications software. This includes user support for remote terminal installations.
Applications Programmer	Paul Spencer	Phone 228. Paul is in charge of, and is the resident expert on LARSYS and other applications programs.
Systems Analyst	Sue Schwingendorf	Phone 270. Sue is responsible for providing the system support for all remote terminals.
Digital Display Technical Assistant	Donna Scholz	Phone 226. Donna's primary function is to aid users of the Digital Display unit, and to provide consulting and education on its use.
Basic Systems Manager	Howard Grams	Phone 224. Howard's group is responsible for systems software (E.g. CP67 and CMS) and general software, system configuration, and general user services.
Systems Programmer	Jeanne Etheridge	Phone 228. Jeanne is designated as the primary user contact. If she can't handle an inquiry or a problem, she can get it taken care of. Her own primary area is in handling ID's and consulting with users on CP/CMS and programming questions.
Operations Manager	Bill Hockema	Phone 226. Bill's group is responsible for keeping the computer system running and for providing access to it.

Users at remote terminal sites should contact their site specialists with all questions and problems, instead of contacting LARS personnel directly. The site specialists are then responsible for interfacing with their Purdue/LARS counterparts if necessary.

The current remote site specialists are listed below:

PURDUE/LARS	- Technical Advisor	- Terry Phillips
	System Specialist	- Sue Schwingendorf
	Techniques Specialist	- Barbara Davis
NASA/JSC	- Technical Advisor	- John Sargent
	System Specialist	- John Cornwell
	Techniques Specialist	-
NASA/GSFC	- Technical Advisor	- William Alford
	System Specialist	-
	Techniques Specialist	-
NASA/Wallops	- Technical Advisor	- Harold Maurer
	System Specialist	- Tom Savage
	Techniques Specialist	- David Hancock
ISU	- Technical Advisor	- Paul Mausel
	System Specialist	- Dick Hyde
	Techniques Specialist	-
EDC	- Technical Advisor	- Fred Waltz
	System Specialist	- Dave Greenlee
	Techniques Specialist	-

1.4 ADMINISTRATIVE PROCEDURES

To use the LARS computer, a "Master-Account", which details such things as who will pay for services used, must be established with the LARS Computational Facility. Next, individual computer ID's must be established.

A user must have an ID established in the computer's operating system before he can use the computer. ID assignment defines the resources available in a user's virtual machine when he logs in at a terminal. One of these resources is private disk storage that can be used for maintaining user data files and computer programs.

Associated with each ID is a "password". To use the computer a user must give the login command using his authorized ID. The machine will ask for his password, and the user must type the correct password to gain access to the machine.

Accounting procedures keep track of the number of times each ID obtains access to the computer, how much CPU time is used, Larsys function usage, which dedicated devices are used, and other accounting information useful for

determining resource needs and usage. Three types of reports are sent to the principal investigator and the project managers each month: a computer usage report (broken down by individual ID's), a Larsys usage report, and a copy of the billing statement for the month.

1.4.1. HOW TO ESTABLISH A LARS COMPUTATIONAL FACILITY MASTER-ACCOUNT. Access to the LARS computer is obtained by first completing the form "REQUEST FOR SERVICES - LARS COMPUTATIONAL FACILITY". A sample of this form is reproduced in Appendix B. This request for services must be completed by a project principal investigator and sent to the computational facility manager (Royal Sand) for approval and processing. The form may be obtained from the LARS Business office or from the Computer Services secretary. The request will specify the amount of funding requested for computer services, the effective dates of service, and the Purdue University account to be billed. Also included is the name of the project or account, the name of the principal investigator (who is responsible for all usage of the account), and (optionally) the names of up to three project managers who are delegated authority to request ID's or other services to be billed to the account.

1.4.2. HOW TO ESTABLISH A LARS COMPUTER ID. Once a Master-Account has been approved and established, the principal investigator or a project manager may, at any time, request that one or more ID's be established. An ID is a name and an associated password that allows access to the computer and provides security. Usage of the computer by each ID is reported to the principal investigator and project managers. An ID is established by completing the form "REQUEST FOR LARS COMPUTER ID" for each ID. A sample of this form is reproduced in Appendix C. The completed form should be sent to the Systems Programmer (Jeanne Etheridge) for processing. The form may be obtained from the computational facility secretary or from Jeanne. A copy of the form will be returned when processing is completed.

Line (2) of the ID request form must be signed by the principal investigator or the project manager who is responsible for ID requests. This Master-account or project is named in line (3).

Each week the accounting system processes charges for all the ID's, compares the total charges with the amount available in the Master-account, and checks the Master-account termination date. If a manager wishes to be notified that this particular ID has exceeded or nearly exceeded a certain number of CPU hours, he should fill in that number of hours in line (4). Similarly, if a manager wishes to have an ID terminate before the Master-account termination date, he should fill in the desired date in line

(5). He will be notified about two weeks before the date.

The ID and password in line (6) can be made up of any string of one to eight non-blank characters.

One or more boxes, as appropriate, should be checked in item (7) to indicate what virtual machine capabilities are requested. If 'LARSYS' is requested, it will include as much CMS as is needed (including one cylinder of permanent disk storage space). In general, one should check 'CMS' only if (in addition to running operational programs) facilities are needed for writing and debugging programs. If CMS is requested, this will normally include 4 cylinders of permanent disk storage space. If unusual characteristics (unusual core size, unusual disk size, access to special disks, etc.) are required, they can be described under 'SPECIAL FACILITIES'. It is recommended that users requesting CMS attend an introductory course (generally given at the beginning of each semester) on CP67 and CMS. (For more information on this course, contact Jeanne Etheridge.)

If any magnetic tapes are to be written on using this ID, they should be listed in section (10). The "owner's name" listed there presumably ought to match either the name on line (2) or one of the names on line (8). (See section 1.4.5 for more information on magnetic tape usage.) If there are no existing tapes available for this ID and the project manager wishes to purchase some, he should fill in the owner's name one time for each tape wanted in the blanks in item (10) and write this note at the bottom of the form: "Please purchase ___ tapes". Jeanne will refer this tape purchasing request to Bill Hockema, the operations manager, and will fill in the proper tape numbers in the corresponding blanks before she returns a copy of the form to the manager.

1.4.3. HOW TO REQUEST CHANGES IN A COMPUTER ID OR MASTER-ACCOUNT. Any request for changes in a master-account must come from the original principal investigator and be directed to Royal Sand. Examples of such changes might include increase or decrease funding authorized, extend expiration dates, etc. Any request for modifications to a computer ID should be directed to Jeanne Etheridge and should come from either the principal investigator or a project manager who is responsible for ID requests. Most requests for changes can be handled over the telephone, or by sending an informal note. Examples of changes might include changing the password, increasing or decreasing the number of CPU hours authorized, changing the expiration date, deleting the ID, or adding to or deleting from the list of tapes authorized to be written on by an ID.

1.4.4. ACCOUNTING PROCEDURES AND REPORTS. Each week the system accounting data is run through an accounting program. A memo is generated and sent to the project manager if an ID will expire within the next two weeks or if it has overrun (or is about to overrun) the maximum number of hours that had been specified on the ID request form. A return form is attached to the memo which the project manager may fill out to request more hours, delete the ID, or change the expiration date. If no response is received within the seven-day grace period, and the ID has overrun the hours funded, the ID will automatically be deleted.

At the end of each month, three accounting reports are sent to the principal investigator and each project manager. The first one is a one-page report giving the computer time used by each ID in the project, with totals for the project appearing at the top of the page. Included in the information given are the number of terminal sessions, number of batch jobs run (see section 4.3), total hours (clock-time) attached to the system (broken down by terminal sessions and batch jobs), and total CPU hours used this month (also broken down by terminal sessions and batch jobs). At the far right of the page are summaries of the account status, including the number of CPU hours requested for the account and the total number of hours already used since the starting date of the project.

The second monthly report gives details of LARSYS usage for the month. It is a one-page report for the project and contains the following items for each LARSYS function: number of times used, number of check-out runs, elapsed clock time, virtual CPU time, and total CPU time. Each of these three times is further subdivided into total, minimum, average, and maximum times. Totals are included.

The third monthly report is in the form of an itemized statement of charges. This report is the one that contains the rates and total charges for each of the computational facility services used during the month. It includes the information from the "REQUEST FOR SERVICES" form, the amount used and remaining prior to this month, amount charged this month, amount used and remaining as of the end of this month, and an itemized list of charges.

1.4.5. MAGNETIC TAPE USAGE POLICY AND PRACTICE. The LARS Computational Facility currently manages about 5000 reels of magnetic tape. Many of these reels comprise a data base of remote sensing multispectral image data. In addition, individual users may have tapes assigned to them for use in storing their own data or results.

All magnetic tapes have tape numbers assigned and are

kept in correspondingly numbered slots in the tape racks. The computer center staff will ensure that each assigned reel bears a "tape identification label" containing the following information:

a. Tape Number
b. General use for which tape is intended
c. Name of person responsible for tape
d. List of ID's authorized to write on tape

Any master-account may purchase any number of tapes. This can be arranged by the project manager together with Jeanne Etheridge or Bill Hockema, the Operations Manager. As part of this procedure an "owner" will be designated for each tape. This "owner" may make changes (e.g. add or delete items from list of ID's authorized to write on tape) by contacting Bill or Jeanne.

Although each tape is assigned to a specific person (the "owner") who is responsible for its contents, the computer operators and operations supervisor are responsible for the physical handling of the reels. (No tapes are to be removed from the computer room, except by going through the computer operations supervisor.) Any tape may be read and requested by any user, however only ID's authorized by the tape "owner" and listed on the "tape identification label" will be able to request that a tape be mounted so that it can be written on.

In addition, users are strongly urged to request that a "tape contents label" describing current contents and date last written be made for each tape each time it is written. This can be done as suggested by the following examples:

Example 1 - To create a new contents label:
M CP TAPE 999 NEWLABEL = 'CLASSN RESULTS - RUN 66000600'

In this case the computer operator will write out a label with today's date and the requested information and use it to replace all old labels on the tape. The information will also be recorded in the tape usage log.

Example 2 - To add to a label:
M CP TAPE 999 ADDLABEL = 'FILE 3 - RUN 66000601'

In this case all old labels on the tape will remain, and a new one with today's date and the requested information will be added.

1.5 OPERATIONAL PROCEDURES AND GOALS

The LARS computer is in operation 24 hours a day except between 5PM Saturdays and 3PM Sundays and Purdue holidays.

In addition, scheduled preventive maintenance (currently between 8am and 10am Friday mornings) may preclude availability to users. Bulletin boards, log messages, and the news service of the LARSYS system (see Section 3.2) will announce permanent and temporary changes in the availability schedule. Advance notice of temporary downtime for maintenance (if necessary at other than regular maintenance period) will be given in the log message.

General policy is to have two computer operators on duty at all times (three during the prime shift). This will ensure adequate response to user requests as well as enable users to obtain help in resolving operational problems they may encounter.

Expected typical levels of system availability and reliability are described below:

1. There should not be more than an average of two unscheduled shutdowns (system crashes) experienced by any user in a week. Any such system failure should be repaired within one hour.
2. LARS terminals should be operational the same hours as the system, with less than an average of one failure per week per terminal lasting not more than one working day.
3. User requests (such as tape mounting and device attachment) should be honored within two minutes. Card or printer output at the central computer site should be available within five minutes of production.
4. There should be sufficient tape units available so that LARSYS users can obtain one tape unit within 10 minutes of a request or two tape units within 30 minutes of a request or more than two units within 10 hours.
5. The digital display at the central computer site should be operational the same hours as the system, with less than an average of one hardware failure per week. Maximum recovery period from hardware failures should be less than five working days.
6. The Computational Facility is closed during Purdue holidays which are:

   New Years — Memorial Day
   July 4th — Labor Day
   Thanksgiving and the day after
   Christmas
   Two special days during Christmas - New Years week (designated by Purdue president)

2.0 DESCRIPTION OF HARDWARE, SOFTWARE, AND DATA LIBRARY

2.1 THE COMPUTER AND ASSOCIATED HARDWARE

The LARS computational facility is based around an IBM 360 Model 67 machine. The current configuration includes 512K bytes of core memory (i.e., 128K 32-bit words). Unit record equipment (two card readers, one punch, and two printers) as well as user terminals are connected to the CPU via a multiplexor channel. Nine 9-track and one 7-track magnetic tape units are connected to the CPU via two selector subchannels. A drum storage unit has a dedicated selector channel, while eight disk storage drives share a second selector channel with a special digital image display and editing unit.

The Model 67 is a unique member of the 360 series in that it has special hardware features to perform dynamic address translation and hence to operate efficiently in a time sharing mode.

2.2 COMPUTER SYSTEM SOFTWARE

2.2.1. CP-67 AND THE VIRTUAL MACHINE CONCEPT. The basic monitor program or control program under which the LARS computer operates is called CP-67. CP is a multi-programming package which uses the special time sharing hardware features of the Model 67 to create an environment in which it appears to each one of several users that he has complete control of a dedicated model 360 machine, complete with I/O devices. These apparent machines are called virtual machines since they are software created and do not exist in any physical sense. The virtual 360 is indistinguishable to the user and his programs from a real System/360, but it is really one of many that CP is managing. CP allocates the resources of the real machine to each virtual machine in turn for a short "slice" of time, then moves on to the next user's virtual machine -- thus time sharing.

Since the real machine does not have sufficient real core storage for all users' virtual core, a technique called "paging" is used by CP. Virtual core is divided into 4096 byte blocks called "pages". All pages except those currently in use are kept by the system on secondary storage (drum or disk), and are called into and swapped out of real core on a demand basis. In addition, all virtual machine input-output is handled by CP -- however, all these operations are completely transparent to a user and his virtual machine.

Since the virtual machines are simulated, in principle their configurations may differ from each other and from the real machine. In practice, most virtual machines have the following configuration:

512K bytes of core storage

Operator's console	-	(address 009)
Spooled card reader	-	(address 00c)
Spooled card punch	-	(address 00d)
Spooled printer	-	(address 00e)
Disk storage drive	-	(address 190)
Disk storage drive	-	(address 191)
Disk storage drive	-	(address 19c)

CP also provides, as part of the virtual computer, commands that parallel the buttons and switches on a real machine's operator's console. The user can issue these commands from his terminal, and thus, his terminal becomes the pseudo-console for his virtual machine.

CP-67 simulates card reader, punch and printer operations for a virtual machine. If a program running on a virtual machine is to process a card file, that card file must first be read into CP, headed by an ID card to identify the intended user's virtual machine. It is then stored as a disk file in CP's so-called spooling area. When the virtual machine requests card-reader input, CP supplies it with card images from the spooled input file. The same process works in reverse for printer and punch output: a disk spooling file is created, which is later transferred by CP from disk to a real printer or punch.

2.2.2. CMS. After the control program creates the virtual computer, that virtual computer must be equipped with its own operating system to provide support for the programs to be run. The programming system most commonly used at LARS is called the Cambridge Monitor System, or CMS.

CMS is a single-user, conversational operating system designed to provide full use of a System 360 machine using a simple command language that can be entered at the terminal. CMS provides a full range of capabilities - creating and managing files, compiling, debugging, and executing programs, etc.

Section 5.1 contains more information on CMS.

The LARSYS Version 3 system (Section 2.3) is based on CMS.

2.3 APPLICATIONS SOFTWARE

2.3.1. LARSYS. LARS' capability for processing multispectral remote sensing data is implemented as a computer software package known as LARSYS. The basic intention of the data analysis part of the package is to facilitate man-machine conversation so that the analysis scientist may more quickly pose questions and obtain results.

The LARSYS system is extensively documented (See Section 3.3) and the user is referred there.

2.3.2. OTHER APPLICATIONS SOFTWARE. There are perhaps a hundred other miscellaneous supported programs. The most widely used is *PHOTO, a digital display program. In addition, a large number of old or experimental miscellaneous programs are cataloged and archived in the so-called "unsupported program" file.

2.4 DATA LIBRARY

The basic data processed by LARSYS is maintained in a library of Multispectral Image Storage Tapes (data storage tapes). In general, the data from an airborne or satellite-borne multispectral scanner is sampled and digitized if necessary, and then reformatted to produce the computer-compatible multispectral image tape in the particular format required by the LARSYS system. The latter contains the data for each resolution element stored in a packed format, and has a specific address for each point in the form of a scan line number and sample number. Certain other information, such as run number and date, necessary for machine storage and retrieval are also stored in a convenient format.

The system has a disk data file called 'RUNTABLE' that can be accessed by anyone. It contains the essential information about all runs in the data library available for analysis. A listing of it is maintained in the LARSYS system and can be conveniently obtained when desired (using the LARSYS command 'REFERENCE RUNTABLE'). Copies of the listings of RUNTABLE should also be posted at each terminal site for general reference.

3.0 DOCUMENTATION

3.1 LARS COMPUTER USER'S GUIDE

The Computer User's Guide is designed to document the basic information needed to use the computer. It is available to any computer user upon request, and copies are supplied to the Systems specialist at remote terminal sites. Requests for the Guide (as well as requests for all documentation) should be made to the computational facility secretary. (Users at remote terminal sites should request all documentation from their local Systems Specialist.) As changes in information occur, the guide will be kept up to date by preparing replacement pages containing the new information and distributing them to all people who have received copies of the Guide. Anyone who wants to receive such updates should make certain his name is on the list of recipients. Notices of updates will also be posted via the system 'NEWS' facility (Section 3.2).

Suggestions for changes in the User's Guide (this especially includes items which are unclear, misleading, or incorrect) should be directed to Howard Grams.

3.2 THE SYSTEM 'NEWS' FACILITY

Users of the computer have access to a 'bulletin board' or 'news' facility to alert them to updates or changes in programs, facilities, schedules, and documentation. To obtain the latest system news, a user need only (1) login, (2) type 'i larsys', and (3) type 'news'.

The command 'NEWS' will type out the latest system news - a brief file containing items of general interest. More specific information about the LARSYS programming system can be obtained by typing the command 'NEWS LARSYS'. The latest operations schedule can be obtained from the command 'NEWS SCHEDULE'.

3.3 LARSYS PROGRAM DOCUMENTATION

The formal documentation of the LARSYS system is divided into three parts: The "LARSYS Users Manual", the "LARSYS System Manual", and the "LARSYS Program Abstracts."

The "LARSYS User's Manual" (in three volumes) contains a comprehensive description of the functional organization of the system, the processing functions provided, and the manner in which the functions are invoked and controlled. While it is written for the system user, a good knowledge of its contents is essential for any individual who intends to work with the system - be he a user, an analyst, or a programmer.

The "LARSYS System Manual" is directed primarily to programmers and analysts who maintain or revise the system, or write new functions that must be interfaced with LARSYS. It contains detailed information about the hardware and software framework upon which the system was built, the internal organization of the data files, and a discussion of special techniques that were used in the implementation of LARSYS.

The "LARSYS Program Abstracts" comprise a collection of individual documents, each with its unique identifying Abstract number, one for each Fortran, assembler, or EXEC routine in the system. These abstracts are intended for programmers who may need to revise and/or maintain these routines.

Note that up-to-date listings of LARSYS commands and control cards are available from the computer via the 'REFERENCE' command of the LARSYS system.

3.4 IBM MANUALS

A comprehensive collection of IBM manuals describing hardware and software aspects of the system is maintained in the user area at the central computer site. An abridged collection should be maintained near each remote terminal. The more important ones are listed below:

Hardware

Form GA27-3001 'IBM 2740/2741 Communications Terminal - Operator's Guide'

Form GA27-3005 'IBM 2780 Data Transmission Terminal - Component Description'

FORTRAN Language

Form GC28-6515 'IBM System/360 and System/370 Fortran IV Language'

CP-67 and CMS Operating Systems

Form GH20-0859 'Control Program - 67/Cambridge Monitor System - Users Guide'

(Note: This manual is updated for PURDUE/LARS Users with memos describing local additions and modifications. These memos are distributed with the manual.)

4.0 HOW TO USE THE COMPUTER

4.1 SIGNING UP FOR SYSTEM RESOURCES

The configuration of the computer hardware is constantly being monitored and re-evaluated, with attention given to such questions as the usage of and need for scarce resources (tape units, disk storage space, user terminals). Even with a perfect hardware mix, however, there would be times when more users want to use drives or terminals than there are drives or terminals available. The computer operations staff attempts to deal with this problem to ensure maximum user convenience.

One such procedure is that of signing up in advance to use terminals or the digital display unit.

Sign-up policy for terminals is set at the individual terminal locations -- details and sign-up sheets are available at each location.

Since LARSYS automatically requests tape drives from the computer operator when needed, and releases them when done, it is not necessary for LARSYS users to specifically reserve tape drives.

IMORTANT

It should not be necessary to point out that it is very wasteful of resources as well as quite inconsiderate of the "other guy" to sign up for resources you do not use. Accordingly, if your plans change and you are not able to use the terminal you have reserved, you should cancel your request as early as possible. In this respect, observance of "do unto others" will reap you great dividends as, in turn, others "do unto you".

4.2 RUNNING INTERACTIVE JOBS

This section first gives the basic information necessary to operate the terminal equipment, then the basic information necessary to invoke the software system.

4.2.1. OPERATING A 2741 TYPEWRITER TERMINAL. The 2741 is a Selectric typewriter with additional electronics needed for communications. It has two modes of operation: communicate mode and local mode, which are set by the mode

switch on the left side of the typewriter stand. When in local mode, it is disconnected from the computer and functions as a typewriter only, and no information is transmitted or received.

1. Make sure the terminal is powered on. If not, then press the ON portion of the power switch at the right side of the keyboard.

2. Set the margin stops (located on the typing guide just above the keyboard) to the desired positions (normally about 10 and 120). To reset a margin stop, push it in, move it to the desired position, and release it.

3. The paper may be released and straightened by moving the paper-release lever forward (the silver lever to the extreme upper right rear, behind the platen (roller)), and then pushing it back when finished. The paper may be manually aligned vertically (to avoid typing on the printed lines) by pressing in the left platen knob and rotating up or down.

4. Check that the mode switch (on the left side of the stand) is set to COM. The terminal is now ready for use.

5. Depress the ATTN key, and login.

A more detailed description of the 2741 can be found in the publication "IBM 2740/2741 Communications Terminal - Operator's Guide", Form GA27-3001. A copy should be located at each terminal site.

4.2.2. OPERATING A CRT DISPLAY TERMINAL. Typical Cathode Ray Tube (CRT) Display terminals used with the system include the Hazeltine Models 1200 and 2000. More complete instructions are attached to each terminal.

1. Make sure the terminal is powered on. If not, press the POWER-ON button. it should light up (2000), or the power-on light should come on (1200).

2. Check that 'LOCAL' and 'RECEIVE' lights are on. (2000 only)

3. Press 'LOCAL'. The 'RECIEVE' light should go out. (2000 only)

4. Press 'SHIFT' and 'CLEAR' simultaneously. (2000 only)

5. Press 'RESET'. The receive light should come back on. (2000 only)

6. Press 'BREAK', and login.

One should be aware of the following special characteristics of CRT terminals (and of other similar terminals):

A. The BREAK key is used where one uses the ATTN key on a 2741.

B. DO NOT TYPE unless you have a > at the left margin. Unlike the 2741, this terminal cannot lock its keyboard. Instead, it uses the caret as a signal that the keyboard is "logically unlocked". If you type when the keyboard is "logically locked" (that is, when there is no caret), it will be interpreted as an ATTN or BREAK and throw you into CP mode. In such a case, you can recover by typing 'begin' and a carriage return.

C. Use [instead of ¢ to cancel an input line since there is no ¢ on the keyboard. (See special note attached to 1200 terminals.)

D. Any output line longer than 70 characters will be broken, will have a ↑ inserted at the right edge, and will be continued on the next line.

4.2.3. OPERATING A TI PORTABLE TERMINAL. The Texas Instruments 735 Portable terminal may be used anywhere that a standard telephone and AC power are available. In many respects, operation is similar to operation of the CRT display terminals. The major differences relate to attaching the terminal to the telephone and connecting with the computer.

1. Remove the cover from the terminal.

2. Plug the power cord into the back of the terminal and into a 3-prong AC outlet.

3. Check that the terminal switches are set as follows:

LINE FEED	- Single	DUPLEX	- Half
SPEED	- 30	INTERFACE	- INT
PARITY	- Does not matter		

4. Turn the power switch on, and note that the red light comes on.

5. Check that the ON-LINE key is not depressed. If it is, push it again to release it.

6. Dial the telephone number.

7. After the high-pitched beep is heard, place the handset in the muffs at the back of the terminal. Note that the cord goes to the left (marked 'CORD' atop the terminal).

8. Check that the green CARRIER light is now on.

9. Depress the ON-LINE key. The message 'CP-67 online' should appear.

10. Depress 'BREAK', and login.

One should be aware of the following special characteristics of dial-up terminals, as well as the characteristics of CRT terminals listed in section 4.2.2.

A. If the green CARRIER light goes out during a terminal session, the telephone connection has been broken. It will be necessary to re-dial and (probably) to re-login.

B. Noise pulses on a bad telephone connection will look to the system like BREAK (Attention) pulses, which will put CP-67 into CP mode. To recover, one merely types 'begin' and a carriage return.

4.2.4. OPERATING THE 2780 HIGH SPEED TERMINAL. The 2780 and its associated software enable remote user to read cards directly into the spooled reader of his virtual machine (even before he logs in, if desired). He can also receive printed and punched output from his spooled output files.

4.2.4.1. GENERAL CONSIDERATIONS

1. A more detailed description of the 2780 (including error recovery procedures) can be found in the publication "IBM 2780 Data Transmission Terminal Component Descriptions", Form GA27-3005. A copy should be located at each terminal site. In addition, at each site there is a designated system specialist who is familiar with the operation of the terminal and with recovery procedures. In case of trouble,

he should be called.

2. Do not change the setting of the mode switch (the dial switch on the reader/punch console) while any printing, punching, or reading is going on. First press the appropriate STOP key. IF THIS RULE IS IGNORED, THE PRINTER TYPE BAR WILL PROBABLY JAM AMD WILL NEED TO BE RESET. CALL YOUR SITE COORDINATOR.

3. Whenever the OVERRUN, INCP, EQUIP CHECK, DATA CHECK, or PARITY CHECK indicator lights turn on, it is necessary to reset the 2780 before resuming operation. This can be done by turning the mode switch to another setting and then back to the original setting.

4.2.4.2. TO READ CARDS. A deck of cards can be read when there is no other activity on the terminal or by interrupting printing or punching. (In the latter case there is a possibility of overprinting or receiving duplicate print lines when printing is resumed.)

A. There is no activity on the 2780

1. Remove blank cards from card read/punch hopper.

2. Clear the card read/punch stations by depressing the NPRO key.

3. Place your card deck in the hopper and cover it with the card weight. It must be preceded by an ID card (letters ID in col 1-2 and your specific ID beginning in col 10).

4. Turn the mode switch dial to TSM TRSP. CAUTION - Never turn this switch while the terminal is in operation. (Depress the STOP button first.)

5. Depress the END-OF-FILE key.

6. Depress the START key, and keep it depressed until the READY light comes on.

7. After all cards are read, the terminal will commence beeping. You can stop it by depressing the STOP button under the mode switch dial.

B. The 2780 is in active printing or punching.

0. Depress the STOP key under the mode switch dial. (It is recommended you try to do this between pages, since when printing resumes, there is a chance of receiving a duplicate line or of overprinting a line already printed. Similarly, one or two duplicate cards may be produced if punching.)

1, 2, 3. Follow the same steps as in procedure A above. (Note: if you are reading in the single CANPRT or CANPCH cards described below, do not use an ID card.)

4. In rapid sequence:
   (a) turn the mode switch to TSM TRSP,
   (b) hit END-OF-FILE key,
   (c) depress and hold down start key until ready light comes on.

   NOTE: You must do all three within the space of about 5 seconds -- before the terminal starts beeping. If you do not succeed, turn the mode switch to some other position, and repeat beginning at step 4.

5. After all cards are read, the terminal will again start beeping (signifying that it wants to resume printing or punching the interrupted output. Rotate the mode switch to PRINT (or REC) and press START on the printer. Or load blank cards in the punch, rotate the mode switch to PUNCH, and depress the START key under the mode switch dial.

4.2.4.3. TO RECEIVE OUTPUT. To ensure that the 2780 is ready to receive output whenever required, it is recommended that the following setting be maintained at times when other functions are not being performed.

1. Turn the mode switch to REC

2. Ready the printer by depressing the START key on the printer control panel.

3. Ready the punch by placing blank cards in the hopper and then depressing the START key on the reader/punch and holding it in until the READY light comes on.

If only printer output is expected, step 3 may be omitted, and the mode switch in step 1 may be placed either at PRINT or REC. Similarly if only punched output is

expected, omit step 2 and use either the REC or PUNCH positions in step 1.

4.2.4.4. TO CANCEL A PRINTER OR PUNCH FILE. If the 2780 is printing or punching, and the remainder of the output is no longer wanted, it may be terminated by reading in a single card (don't use any ID card) - with CANPRT or CANPCH punched in columns 1-6 depending on whether a printer or punch file is to be cancelled. This single card is read in using the procedure B in section 4.2.4.2. After step 5 is performed, a few more lines will be printed (or cards punched), followed by the message 'OUTPUT CANCELLED BY REQUEST'.

4.2.5. OPERATING THE 2501 CARD READER. The 2501 card reader is used by people using terminals in the Flexlab2 user area. Its operation is somewhat simpler than that of the 2780 described above.

1. Place card deck in hopper and cover with card weight. Don't forget the ID card.

2. Hit END-OF-FILE and then START.

3. If the reader stops before all cards are read, check with the computer operator on duty for assistance.

4.3 RUNNING BATCH JOBS

Batch jobs run in disconnected CMS virtual machines under CP-67. These virtual machines remain dormant until a job is read into the card reader. A user does not need to login to the computer at all to run a batch job -- he merely drops his job into a card reader and his output comes out as soon as the job is done.

Jobs read into these machines are executed in the order in which they are received. The user will receive an almost immediate confirmation (except for jobs for the UTILITY machine) from the system that a batch job submitted has been accepted and entered into the job queue of a batch machine. The position of the job in the queue will also be given. Output is returned to the site(s) specified on the BATCH OUTPUT card.

A user can also query the system at any later time to find out about the current status of his job. Details are given in Section 4.3.3.

If the computer should crash (heaven forbid) while a

batch job is executing, the job usually will be restarted when the computer is brought back up. This depends on how serious the crash was. In the rare case when the job cannot be restarted, the user will receive a message from BATCH (a controller in the batch machine system) informing him that one of his jobs has been lost. That job will be identified by the name of the machine to which it was submitted, the ID, and the time of submission of the job. When a job is lost it must be re-submitted by the user, since neither the system nor the operator has the appropriate deck available.

4.3.1. LARSYS BATCH JOBS. LARSYS Version 3 jobs can be run on any one of three special batch machines and are submitted through a card reader. (Jobs for BTLARSYS can also be submitted by a user logged in at a typewriter terminal.)

The LARSYS batch machines and their characteristics are:

MACHINE	TIMELIMIT	TYPE OF JOBS
SBLARSYS	6 min CPU	Short LARSYS jobs. Turnaround time depends on load, but hopefully will be within half an hour.
BTLARSYS	6 hrs CPU	Long LARSYS jobs. Turnaround time depends on load and time of day, hopefully will be between 3-24 hours.
XBLARSYS	6 hrs CPU	Experimental version LARSYS jobs. Turnaround time depends on load and time of day, but hopefully will be between 3-24 hours.

A job deck consists of the following four header cards followed by the LARSYS request deck.....

1) A CP-67 ID card having the ID of BATCH. ("BATCH" must start in column 10)

2) A "BATCH MACHINE" card with the name of the LARSYS batch machine on which you want the job to run.

3) A "BATCH ID" card with the four fields BATCH ID 'userid' 'username'. The words BATCH and ID appear exactly as shown, separated by one or more spaces. A user inserts his own ID and his name or the name of the person who is to receive the output. The name can be up to 16 characters long, and may include blanks and punctuation. The authorized ring-in ID listed on the tape's labels must match the ID given on this card.

4) A "BATCH OUTPUT" card, with the four fields BATCH OUTPUT 'printloc' 'punchloc'. The words BATCH and OUTPUT appear as shown, separated by one or more spaces. The 'printloc' and 'punchloc' parameters are used to control the location where output is produced. (If these are omitted, they default to Flexlab2.)

LARSYS EXAMPLE - RUN A SIMPLE IDPRINT JOB

This example shows a user named Bill Robinson using the LARSYS *IDPRINT function. His ID is KRON76, and he wants his output to be produced at Flexlab2 (the central computer site).

```
ID       BATCH
BATCH MACHINE BTLARSYS
BATCH ID KRON76 BILL ROBINSON
BATCH OUTPUT FLEXLAB2 FLEXLAB2
*IDPRINT
PRINT RUN(71053900)
END
```

4.3.2. UTILITY BATCH JOBS. A versatile capability for utility virtual machines is available. This system is designed to handle utility-type functions, such as deck listing, deck duplicating, sending listings or decks to other sites, tape copying and dumping, simple FORTRAN compilations, etc. It is also versatile enough to be programmed to handle most other types of jobs.

The utility batch machines and their characteristics are:

MACHINE	TIMELIMIT	TYPE OF JOBS
UTILITY	20 sec CPU	Short utility jobs. Turnaround time expected to be less than 5 minutes.
BTUTIL	20 min CPU	Long utility jobs. Turnaround time depends on load and time of day, but hopefully will be between 3-24 hours.

A job deck consists of the following five cards in order (followed optionally by data cards)...

1) A CP-67 ID card having the ID of BATCH. ("BATCH" must start in column 10).

2) A "BATCH MACHINE" card with the name of the utility batch machine on which you want the job to run.

3) A "BATCH ID" card with the four fields BATCH ID 'userid' 'username'. The words BATCH and ID appear exactly as shown, separated by one or more spaces. A user inserts his own ID and his name or the name of the person who is to receive the output. The name can be up to 16 characters long, and may include blanks and punctuation. Note that if any tape is to be written on, the authorized ring-in ID listed on the tape's labels must match the ID given on this card.

4) A "BATCH OUTPUT" card, with the four fields BATCH OUTPUT 'printloc' 'punchloc'. The words BATCH and OUTPUT appear exactly as shown, separated by one or more spaces. The 'printloc' and 'punchloc' parameters are used to control the location where output is produced. (If these are omitted, they default to Flexlab2.)

5) A job definition control card. Five formats are currently recognized. Each begins in column 1 and must be punched exactly as shown.

```
DECKLIST
DECKDUP
EXEC  filename  parm1  parm2  parmetc
EXECnn
EXEC##
```

If the 'DECKLIST' control card is recognized, all remaining cards in the deck will be printed on the printer (at the location specified as 'printloc' on the BATCH OUTPUT card.)

If the 'DECKDUP' control card is recognized, all remaining cards in the deck will be punched (at the location specified as 'punchloc' on the BATCH OUTPUT card). The number of cards punched will be listed on the printer output from the utility batch machine.

If the 'EXEC filename' control card is recognized, a search will be made for that EXEC file on the LARSLIB 1 source/text library disk. If it is found, it will be executed. One or more optional parameters may be passed.

If the 'EXECnn' control card is recognized (nn are two digits between 01 and 99), a new temporary EXEC

file is created using the next nn cards into the file. That temporary file is then executed. (This procedure is useful for initial checkout and testing of procedures that are intended to go later on the LARSLIB 1 disk).

If the EXEC## control card is recognized, a new temporary EXEC file is created using the cards between the 'EXEC##' card and a '##' card (a card having only ## in the first two columns). That temporary file is then executed.

EXAMPLE 1 - DUPLICATE A CARD DECK

This example shows a user named John Doe duplicating a card deck at Flexlab1. His ID is MYID.

```
ID        BATCH
BATCH MACHINE UTILITY
BATCH ID MYID JOHN DOE
BATCH OUTPUT FLEXLAB1 FLEXLAB1
DECKDUP
   .
   .
   .   } Cards to be duplicated
   .
```

EXAMPLE 2 - PRINT A LISTING OF A CARD DECK

This example shows a user named Jim Dane producing a listing of a card deck. For the purpose of this example, assume that he is located at the Houston remote terminal. He has used his own ID of MSCQJK, but has specified the output to be printed at Flexlab2 instead of Houston and to be labelled with the name of Jeanne Etheridge instead of his own name. In this way Jim Dane can send a copy of a listing of his card deck to be examined by Jeanne Etheridge (say he is having a problem with a job deck and needs to have someone look at his control cards).

```
ID        BATCH
BATCH     MACHINE    UTILITY
BATCH     ID   MSCQJK    JEANNE ETHERIDGE
BATCH     OUTPUT   FLEXLAB2   FLEXLAB2
DECKLIST
```

. } A few cards punched with information describing the rest of the cards.

. } Cards to be listed.

EXAMPLE 3 - COPY TAPES

Any tape copy job can be done, including straight copy, 7 track to 9 track conversion, 1600 bpi to 800 bpi conversion, etc. It is not necessary to know the number of bytes in a physical record (block), and any blocksize up to 32767 bytes is acceptable. (This program - TAPCPY - can also be used from a terminal and full details are given in LARS Program Abstracts 0610 and 0611. It is more versatile than the CMS command TPCOPY, since the latter has a maximum blocksize of 4096 bytes.)

In this example, John Doe is converting from 1600 bpi to 800 bpi. Note that this procedure is useful for producing a tape to be sent to some other computer installation that cannot handle the 1600 bpi tapes that are normally produced at LARS.

```
ID        BATCH
BATCH MACHINE BTUTIL
BATCH ID  QJCK5 JOHN DOE
BATCH OUTPUT FLEXLAB2  FLEXLAB2
EXEC TAPUTL RDCOPY
TAPIN(1052),MODIN(16),TAPOUT(828),MODOUT(17)
```

Notes on Tape copying:

CARD 5 - Contains the letters 'EXEC TAPUTL RDCOPY' in columns 1-18.

CARD 6 - Contains options (in any order) from the following list:

Option	Purpose	Default
TAPIN(XXX)	Tape to be copied from	(None)
MODIN(XX)	Mode of input tape (see below)	MODIN(16)

START(XX)	Start copying at this file on input tape	START(1)
TAPOUT(XXX)	Tape to be copied to	TAPOUT(SCRATCH)
MODOUT(XX)	Mode of output tape (see below)	MODOUT(16)
SKIP(XX)	How many files to skip on output tape	SKIP(0)
COPY(XX)	How many files to copy	Copy until two consecutive EOF marks

CODES FOR MODIN AND MODOUT

CODE	TRACKS	DENSITY	PARITY	CONVERTER	TRANSLATOR
17	9	800 bpi	(not applicable)		
16	9	1600 bpi	(not applicable)		
10	7	556 bpi	Even	Off	Off
9	7	556 bpi	Even	Off	On
8	7	556 bpi	Odd	Off	Off
7	7	556 bpi	Odd	Off	On
6	7	556 bpi	Odd	On	Off
5	7	800 bpi	Even	Off	Off
4	7	800 bpi	Even	Off	On
3	7	800 bpi	Odd	Off	Off
2	7	800 bpi	Odd	Off	On
1	7	800 bpi	Odd	On	Off

A printer file will be created containing a log detailing what was requested and copied, and any error messages if errors occurred. (The error codes are discussed in the documentation of the TAPOP module.)

EXAMPLE 4 - DUMP A TAPE

User John Doe, at Flexlab2, wants to dump the first two files of his tape number 1234. He is using the TAPUTL program (described in more detail in LARS Program Abstract 612).

```
ID        BATCH
BATCH      MACHINE      BTUTIL
BATCH     ID     MYID     JOHN R. DOE
BATCH     OUTPUT    FLEXLAB2    FLEXLAB2
EXEC      TAPUTL    RDDUMP
TAPE(1234),HEX,LREC(10),LFILE(2)
```

Notes on tape dumping:

CARD 5 - Contains the letters 'EXEC TAPUTL RDDUMP' in columns 1-18.

CARD 6 - Contains options (in any order) from the following list:

Option	Function	Default
TAPE(XXX)	TAPE XXX is requested to be dumped	(None)
BCD	Tape is dumped in BCD format	HEX
HEX	Tape is dumped in HEX format	HEX
IREC(XXX)	XXX is the first record in each file to be dumped	IREC(1)
LREC(XXX)	XXX is the last record in each file to be dumped	LREC(99999)
IFILE(XXX)	XXX is the first file to be dumped	IFILE(1)
LFILE(XXX)	XXX is the last file to be dumped	LFILE(1)
MODE(XX)	Mode of tape (See codes in Example 3)	MODE(16)

EXAMPLE 5 - USING THE EXECnn OPTION

John needs to produce a listing of a deck of cards that has been punched with carriage control characters in column 1 of each card. This can be done using the CMS command OFFLINE PRINTCC. He creates a 3 card temporary EXEC file using the EXEC03 control card. This file reads the rest of his deck into a disk file named INPUT CARDS, then OFFLINE PRINTCC's it and ERASE's it.

```
ID        BATCH
BATCH     MACHINE UTILITY
BATCH     ID    MYID    JOHN DOE
BATCH     OUTPUT   FLEXLAB2   FLEXLAB2
EXEC03
OFFLINE   READ   INPUT   CARDS
OFFLINE   PRINTCC   INPUT   CARDS
ERASE     INPUT   CARDS
   .
   .   } Input card deck to be listed.
   .
```

Note in connection with this example that the UTILITY virtual machine is only configured with a 1-cylinder P-disk. Thus the deck of cards that is read into the file INPUT CARDS should not be larger than about 1300 cards, or the file INPUT CARDS will be too big to be contained on the P-disk. This will cause the UTILITY virtual machine to abnormally terminate and log itself out.

EXAMPLE 6 - USING THE EXEC## OPTION

The same job as that run in example 5 can also be run using the EXEC## option. This option does not require the user to count the number of cards in his EXEC file. All he must do is insert a '##' card after the last card in his EXEC file. In this way the size of the EXEC can be increased or decreased easily.

```
ID        BATCH
BATCH MACHINE UTILITY
BATCH ID MYID JOHN DOE
BATCH OUTPUT FLEXLAB2 FLEXLAB2
EXEC##
OFFLINE READ INPUT CARDS
OFFLINE PRINTCC INPUT CARDS
ERASE INPUT CARDS
##
   .
   .   } Input card deck to be listed
   .
```

EXAMPLE 7 - COMPILE AND EXECUTE FORTRAN PROGRAMS

User Joan Dean, at Flexlab2, wants to compile a main program with two subroutines. She also wants the text decks to be transferred to the virtual reader of her own ID. Then she wants to execute the main program and its subroutines.

```
                ID       BATCH
                BATCH MACHINE BTUTIL
                BATCH ID EYED JOAN DEAN
                BATCH OUTPUT FLEXLAB2 FLEXLAB2
                EXEC BFORTRAN DECK XFER EYED GO
(optional)      OFFLINE READ MAIN FORTRAN
                     .  }Main program to be executed
                     .
                OFFLINE READ SUB1 FORTRAN
                     .  }First subroutine
                     .
                OFFLINE READ SUB2 FORTRAN
                     .  }Second subroutine
                     .
                OFFLINE READ SUB3 FORTRAN
                     .  }Third subroutine
                     .
```

Notes on using BFORTRAN...

CARD 5 - contains the letters 'EXEC BFORTRAN' in columns 1-13 followed by options (in any order) from the list below. If no options are specified, only the compilation listing is produced.

Option	Function
NODECK	No text decks will be produced for FORTRAN source programs. (This is the default.)
DECK	Punch text decks for FORTRAN programs
XFER userid	If DECK is listed among the options chosen along with this one, then the text decks will be XFER'ed to the virtual card reader of 'userid' instead of actually being punched.
NOGO	Do not attempt execution (This is the default)
GO	Attempt execution of first program as main program (if there were no compilation errors).

If there are subroutines (or if NOGO is in effect, more than one main program), these must be separated in the

input deck by OFFLINE READ cards. The OFFLINE READ for the first program is optional. The first program must always be the main program if GO is specified.

A printer file will be created containing a compilation listing for all FORTRAN programs. If execution was attempted, the program output will be included with the listings. If errors were found, appropriate messages will appear with the output.

General Notes On Utility Machines.....

1) Each utility machine re-IPLs itself between jobs, clears its P-disk after each job, and detaches any extra unneeded devices (such as tape drives that have been attached, disks that have been linked, etc.) after each job. This is done to provide safety -- to avoid the possibility that one job can affect the following job.

2) Each utility batch machine is configured with a 1-cylinder P-disk at address 191, a 1-cylinder C-disk at address 18f, and the LARSLIB 1 Source/Text library disk at address 18e, logged in as the E-disk.

3) It is permissible for a user EXEC file to link to a temporary disk or other disk and log it in as a P-disk, replacing the 191 disk. The batch machine can "clean itself up" if this is done. However, replacing the C-disk or E-disk must be avoided.

4.3.3. BATCH QUERY FACILITY. It is possible for a user to find out about the status of batch jobs regardless of whether they are finished, in process, or still in the queue. If the job (or jobs) are finished, the user will be told when they started and finished and where the output was produced. If a job is in process, the user will be told when it started. If jobs are in the queue, their postitions in that queue will be given.

A query request can be initiated to find out about the status of all the batch jobs that a user has submitted during the past several days by submitting a card deck of the following format:

```
ID       BATCH
BATCH QOUT PRINTER FLEXLAB2 JOAN DEAN
BATCH QUERY EYED
```

This deck requests the status of all batch jobs for userid 'EYED' (specified on the BATCH QUERY card) with the output going to the printer at FLEXLAB2 (specified on the

BATCH QOUT card). The printer output will be labeled with the name JOAN DEAN.

The output produced from this request will include a list of all jobs run under userid 'EYED' for any batch machine. Information describing each job includes the machine to which it was submitted, time and date submitted, print and punch sites,and an indication of the status of the job.

5.0 NOTES FOR PROGRAMMERS

5.1 CMS

Most usage of the LARS computer for program development is through the use of CMS (Cambridge Monitor System) -- See Section 2.2.2. The Computer Facility Basic Systems Group periodically conducts a short introductory course in the use of CMS, and it is expected that each person who wants to use CMS will have first attended the course.

5.1.1. DISK SPACE FOR CMS USERS. When authorization to use CMS is approved and an ID is set up, the user will have private disk space defined for his virtual machine (his P-disk) that may be used to store programs, procedures, and data from one terminal session to the next. The amount of such disk space actually available on the real computer is limited, and each user is expected to develop and practice procedures for making the most efficient use of his P-disk. This includes, for example, keeping files not being used at the moment on backup storage (tape or cards).

Standard P-disk sizes for CMS users are 4 and 7 cylinders. One cylinder can contain almost 1500 80-character records. There is a monthly charge for private disk storage, depending upon the size of the disk (see section 1.2). The project manager who is responsible for ID's for his project may call Jeanne Etheridge or write her an informal note if he wishes to change the size of a P-disk for an ID.

The user of the ID himself may contact Jeanne if he wishes to have a read or write password assigned to his P-disk. A disk password is necessary if a CMS user needs to obtain access to the disk while he is logged on under another ID. A disk password is commonly used to allow a CMS EXEC routine, running in a utility batch machine, to obtain access to the disk in order to load programs into core storage.

5.1.2. BACKUP PROCEDURES. It should be emphasized that each CMS user should frequently backup his entire disk to tape for safety purposes. The computer staff does not backup any user disk areas, and although it seldom occurs, a hardware crash could cause loss of all files on any disk. Far more likely is the occurrence of an inadvertent user error that wipes out his disk, or makes it unreadable. A convenient method of backing up user CMS disks is provided by the CMS command BACKUP - it is described in an addendum to the CP/CMS Users Guide, and its regular use is highly encouraged.

5.1.3. PRINTER AND PUNCH OUTPUT. All printer and punch output is normally produced at the main computer site. A special CP command exists ('REMOTE') that is used to cause output to be produced at a remote terminal site. It must be issued by any user (including a CMS user) who wants his output produced on his 2780 at his remote terminal site. LARSYS contains a call to a system routine that automatically issues the proper REMOTE command by sensing which terminal is being used and then REMOTEing printer and punch output to the same physical location.

The CMS user can utilize the same automatic process of sensing his location and issuing the proper REMOTE command. This can be done by using the CMS command WHERE -- it is described in an addendum to the CP/CMS Users Guide. The recommended method of use is to include the WHERE command within the user's PROFILE EXEC, so that it is automatically issued whenever he logs in and ipl's CMS.

Appendix A. LARS Computational Services and Rates
July 1, 1975 - June 30, 1976

ITEM	UNIT	RATE/UNIT
Computer service, CPU time	1 hour	$265.00
Terminal system (interactive)	1 hour	37.00
Digital display time	1 hour	22.00
7-track tape drive time	1 hour	24.00
Disk storage space	1 cyl/mo.	1.50
Table digitizer	1 hour	6.00
A/D converter	1 hour	60.00
LANDSAT reformatting	1 job	90.00
Geometric correction run	1 run	185.00
Geometric correction data points	1 million points	106.00
Image registration run	1 run	880.00
Image registration data points	1 million points	620.00
Exotech reformatting	1 run	27.00
LARSYS reformatting	1 run	57.00
Professional staff time	1 hour	25.10
Professional assistant time	1 hour	13.40
Technical assistant time	1 hour	8.65
Service staff time	1 hour	7.20
Clerical staff time	1 hour	5.65
Student staff time	1 hour	5.15
Digital tapes	1 tape	12.00
Polaroid film		
Black and white	1 pack	3.50
Color	1 pack	5.00
Positive-negitive	1 pack	4.30
Digital display photo, job	1 job	115.00
Digital display photo, per frame	1 frame	165.00
Digital display photo, per picture	1 picture	25.00
LARSYS User's Manual, per order	1 order	20.00
LARSYS User's Manual, per manual	1 copy	40.00
LARSYS documentation	1 copy	995.00
LARSYS Version 3.1 update	1 copy	540.00
LARSYS Educational Package	1 package	925.00
Student and instructors notes	1 package	300.00
Student notes	1 set	12.00
LARSYS Version 3 program education	1 course	1,775.00
LARSYS program education	1 week	695.00

Rates do not include shipping costs.

The above rates apply only to Purdue University accounts. Outside non-profit organizations will be charged an additional 40% for administrative costs. All other users will be charged at a rate twice the rate given above.

Revised 11/17/75

REQUEST FOR SERVICES
LARS COMPUTATIONAL FACILITY
UNIVERSITY ACCOUNTS

Department_____ Applicant_____

☐ New Account ☐ Changes in Old Account

Funding_____ Additional Funding_____

Start Date_____ Decrease in Funding_____

Termination Date_____ New Termination Date_____

Project Name and Description:_____

Project Managers:_____,

_____,_____

Project Leader/Principal Investigator Approval: I understand that on the termination date above or when my account runs to a near zero balance, my account will be closed unless I modify the request.

Date:_____ Signature:_____

University Account_____ Dept. Ref. (if any)_____

Head of Department or School Approval: I certify that funds are available in the above account and authorize the LARS Computational Facility to begin work immediately and bill the account. In the event funds are not available in the account indicated, other funds will be made available to pay for the work completed.

Signature:_____

Instructions: Form is available from LARS Computational Facility Account Clerk, applicant fills in blanks above with aid from facility personnel, approval is obtained from project leader/principal investigators and department head, form is submitted to Account Clerk, a facility account number is assigned, account is approved by Deputy Director of LARS, and copies of forms are sent to all persons listed above and Computational Facility Manager.

LARS Master Account Number:_____

Approved by Deputy Director of LARS:_____

REQUEST FOR LARS COMPUTER ID

(1) Date of Request _____

(2) Requested by _____
(Principal investigator or Manager of Master-account or project)

(3) Name of Master-account or project to be charged

_____

(4) Number of CPU hours to be allowed (optional)

_____

(5) Expiration data for this ID (optional)

_____

This Box for System Programmer Use Only

Account No. _____

USERID _____

Password _____

Approved _____ Init _____

Installed _____ Init _____

Deleted _____ Init _____

Modifications:	Date	Init

(6) ID Requested _____ Password Requested (Used at login time) _____

(8 Char. or less) (8 Char. or less.

(7) Capability Requested:

☐ LARSYS
☐ CMS

Special Facilities: (e.g., special disk passwords, core size, etc.)

_____

_____

_____

(8) Person(s) who will be using this ID _____

(9) Description of work to be done _____

_____

(10) Tapes allowed to be written on using this ID:

Tape No.	Owner's Name	Tape No.	Owner's Name	Tape No.	Owner's Name