Guide to Computing

at ANL

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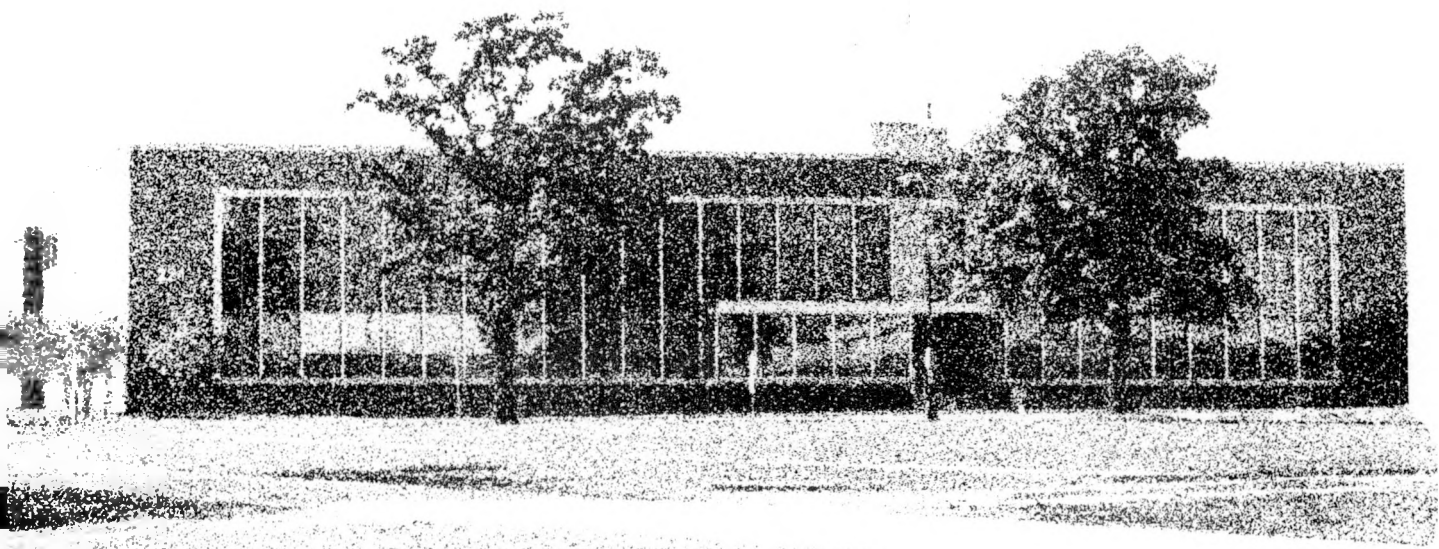
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By

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PREFACE

Guide to Computing at ANL (1) acquaints you with the various computers, computing systems, and computing procedures at Argonne and (2) assists you in selecting the computer, system, network, and software with which you can do your work most efficiently. You should also refer to *Recommended Documentation for Computer Users at ANL* (ANL/TM 379, REVISION 2) for current information about new and updated documents and to the monthly *Argonne Computing Newsletter* for the most recent information on CTD equipment, software, and policies.

The Computing and Telecommunications Division (CTD) provides a state-of-the-art computing and telecommunications foundation for Argonne National Laboratory's scientific and technical programs and administrative activities. To fulfill its mission, the Division engages in three areas of endeavor: Scientific Research and Development, Management Information Systems, and Computing and Telecommunications Operations. Each area is headed by an Associate Division Director.

In the Scientific Research and Development area, CTD:

- Performs research and development in advanced scientific computing and telecommunications technologies.

- Performs applications research in supercomputing, networking, scientific visualization, parallel processing, and other areas of computer science.

- Participates in developing Laboratory initiatives and technology transfer programs in scientific computing.

In the Management Information Systems area, CTD:

- Provides leadership in optimizing computing and information services.

- Works with divisions, departments, programs, user groups, and Laboratory management to define needs and priorities.

- Coordinates the development of and provides maintenance for the business-related computing requirements of the Laboratory.

- Provides leadership in the selection and integration of administrative computing systems.

In the Computing and Telecommunications Operations area, CTD:

- Manages the Laboratory's central computing production systems.

- Manages the Laboratory's voice and data communications systems.

- Coordinates the development of and provides assistance for an integrated hierarchy of computing systems.

  — Provides guidance in the use of supercomputers and large-scale central computers.

  — Provides resources, technical guidance, and other assistance for distributed minicomputers, scientific and engineering workstations, and personal computers.

- Provides leadership in disseminating computer-related technologies throughout the Laboratory.

  As a whole, CTD:

- Works with all segments of the Laboratory to determine requirements and priorities for computing and telecommunications needs.

- Develops plans, prepares recommendations, and implements computing policy for the Computing Policy Committee.

- Provides leadership in research, development, and implementation of computing technologies.

In addition to CTD, there are other service organizations that perform complementary services:

- The National Energy Software Center (NESC) maintains a computer software exchange and information center. NESC distributes software associated with Department of Energy (DOE)-sponsored research projects to organizations (e.g., universities and other DOE contractors). These programs run on IBM computers, Digital Equipment Corporation (DEC) computers, Control Data Corporation (CDC) computers, or other computers. A catalog of these NESC programs is available from the NESC office in Building 201.

- The Electronics Department provides services in the design, development, and fabrication of real-time data acquisition and control systems and computer-based instrumentation. Electronics also provides design, product recommendation, installation, maintenance, and repair services for IBM personal computers and compatibles, the Apple Macintosh, the Digital Equipment Corporation (DEC) VAXstation, the MicroVAX, PDP-11 systems, Sun and NeXT workstations, local area networks, and other computer-related hardware.

- Graphic Arts provides services in presentation graphics and document production.

CTD has implemented the Laboratory's Computer Protection Policy (which appears in Appendix D). For detailed protection procedures, see *Guide to Computer Protection at ANL* (ANL/TM 413).

Several sources of assistance and information are available to Argonne computer users. You should become familiar with these:

- Current System Status Recorded Message. If you have difficulty connecting to the central computers or networks, check the Current System Status Recorded Message at extension 2-5466. If this message does not indicate a difficulty, call extension 2-5421. Computer operators are available 24 hours to make sure that the systems and networks are available.

- The Document Distribution Counter. Unless otherwise noted, all documents referred to in *Guide to Computing at ANL* are available at the Document Distribution Counter (Building 221, Room A-134). You can pick up documents in person or order them by calling extension 2-5405. *Recommended Documentation for Computer Users at ANL* (ANL/TM 379, REVISION 2) will help you identify appropriate documentation for your computing needs.

- The *Argonne Computing Newsletter*. This monthly CTD publication contains articles on new computing equipment, software, policies, and sources of information. Argonne employees with accounts on the central computers automatically receive the *Newsletter*. Others may subscribe by calling Claudette DaCosse at 708-972-5415. You should consider it your primary source for recent CTD developments.

- The Consulting Office. The CTD User Services Section offers consulting services for all Argonne computer users. You can call the Consulting Office at extension 2-5405; come in person to Building 221, Room A-139; or send an electronic mail note (see Table 3).

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FIGURES

CHAPTER 1

AVAILABLE COMPUTERS AND SERVICES

This chapter focuses on centrally available computers and services in the context of the larger Laboratory computing environment. Argonne computer users have available several computers in Building 221 (a Cray X-MP/14, two IBM 3033s,[1] a DEC VAX cluster,[2] an Intergraph 200, and the Advanced Computing Research Facility [ACRF] computers), several offsite high-performance computers, three Hewlett-Packard administrative computers, several division-owned distributed VAXes, some NBI word-processing systems, and many scientific workstations and personal computers.

THE CENTRAL ARGONNE COMPUTERS

The central Argonne computers (located in Building 221) consist of a Cray X-MP/14, two IBM 3033s, and a DEC VAX cluster (currently consisting of a VAX 8700, a VAX 11/750, and a VAX 8250). CTD upgrades these computers as the Laboratory's computing demands increase and change. Figure 1 shows the current central computer configuration.

Argonne computer users can access both interactive and batch programming environments on any of these computers. For listings of software and programming languages available on the central computers, see Table 5 in Chapter 4, Table 6 in Chapter 5, and Table 8 in Chapter 6.

To establish an account on any of the central computers, contact Account Services at extension 2-5425 or come to Building 221, Room A-147.

The Cray X-MP/14 Computer

The Cray X-MP/14 is configured with one central processing unit (CPU) and four million (64-bit) words of directly addressable random access central memory; it is field-upgradable to a dual-processor system with up to 16 million words of memory. It also includes an input/output (I/O) subsystem with four million words of buffer memory, four 5-billion-byte capacity DD-40 disk drives, and an IBM-compatible block multiplexor channel that connects to the IBM 1600/6250 bpi tape drives. The Cray X-MP/14 uses the UNICOS operating system (Cray Research, Inc.'s version of the AT&T Unix System V operating system with enhancements from the University of California at Berkeley [4.x bsd]).

CTD has configured the Cray to run most efficiently doing large batch production jobs. (In the batch mode, the system receives and executes jobs submitted by users without further communication with those users.) A limited amount of interactive graphics is available; however, until CTD upgrades the Cray with more memory, you should use it primarily as a batch machine.

CTD offers a Transmission Control Protocol/Internet Protocol (TCP/IP) Ethernet gateway to the Cray through a Sun 3/280 processor. Access to the Cray X-MP/14 batch system for onsite users is possible through the MVS front-end station installed on the central IBM computers or the DEC 8250 VAX Supercomputer Gateway that implements full Cray access from VAX computers on the Laboratory-wide Digital Equipment Corporation network (DECnet). Offsite users can access the Cray through the MVS front-end station at BITnet node ANLOS.

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[1] By late FY1990, Argonne will replace the existing IBM 3033s with an IBM 3084Q-class computer that is approximately twice as fast as the combined speed of the existing IBM 3033s.

[2] The DEC VAX cluster is a set of VAX computers in Building 221 that access a common set of disks and tapes.
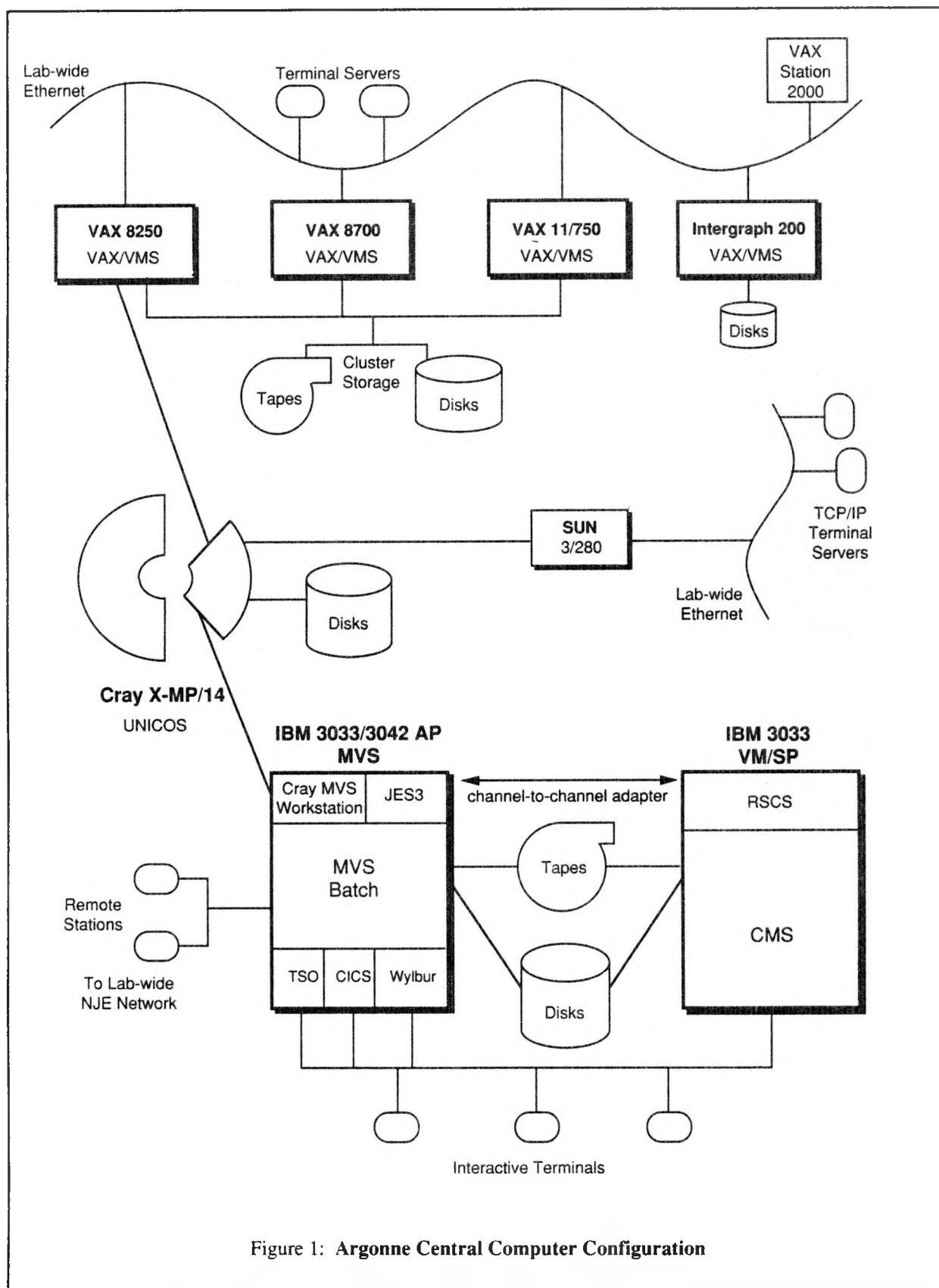
Figure 1: **Argonne Central Computer Configuration**

Software available on the Cray X-MP/14 includes:

- Programming languages, including Fortran (CFT and CFT77 compilers), C, Pascal, CAL (Cray Assembler Language), and the cdbx interactive debugger.

- The Disspla graphics library.

- Mathematical subroutine libraries, including the International Mathematical and Statistical Library (IMSL), the Numerical Algorithms Group (NAG) library, and the DOE SLATEC library.

- Cray-supplied UNICOS software libraries of mathematical functions (libm), routines for Fortran-specific features (libf), I/O routines (libio), scientific application routines (libsci), and utilities (libu).

- The Massachusetts Institute of Technology X Window library.

- The Cray-supplied UPDATE source code maintenance utility. (The Historian program in MVS is upward-compatible with Cray UPDATE.)

To obtain online HELP, UNICOS users can enter (in lowercase letters):

    man passwd

A variety of Cray vendor documentation is available at the Document Distribution Counter.

The Central IBM Computers

The IBM 3033 computer is a byte-addressable virtual memory machine with a sixteen-million-byte virtual address space. The VM operating system provides batch and interactive computing with CMS; the MVS operating system provides batch and interactive computing with MVS batch, Wylbur, MVS TSO, and CICS. The two IBM 3033s at Argonne are called the "red 3033" and the "yellow 3033."

The CMS Interactive Service

The Conversational Monitor System (CMS)[3] is an interactive service that runs on the red IBM 3033 computer under the operating control program called Virtual Machine Facility (VM/370). (In the interactive mode, you converse with the operating system.) When you are using CMS, the following software packages are available:

- The Xedit text editor for creating and editing files in line-by-line or full screen mode.

- Programming languages, including Fortran (VS and H Extended compilers), Pascal, Basic, the PL/I Optimizing compiler, Assembler, C, and Speakeasy.

- Graphics packages (including Cuechart, Tellagraf, Disspla, Data Connection, SAS/Graph, and Surface II).

- File sorting and merging for small files (those with a few thousand records).

- The Waterloo Script text processing program.

- Mathematical subroutine libraries (including AMDLIB, IMSL, and NAG).

- The SAS statistical package.

- The PROFS office automation package.

- The REDUCE symbolic algebra program.

- Other application packages (including the CSMP III and THTB modeling programs).

- Computer-based instruction on a variety of computing topics.

A library of user-contributed programs and tools (execs) is also available on a special minidisk called the Z-disk. To use these programs, enter (in CMS):

    EXEC ZDISK

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[3] "CMS" is widely recognized as an acronym for IBM's Conversational Monitor System and is so used in this document. Do not confuse "CMS" with the DEC Code Management System.

To find out what execs are available, enter (in CMS):

    TYPE ZDISK INDEX Z

Although CMS has its own disk data space unshared with any other system, there are procedures to transfer files easily between CMS and other systems (e.g., Wylbur). For more information about transferring files to and from CMS, enter (in CMS):

    HELP OSSEND

Or enter (in CMS):

    HELP OSGET

Or enter (in CMS):

    HELP SENDFILE

In addition, you can submit simulated card decks from CMS to run on the MVS batch system. For information on this process, enter (in CMS):

    HELP OSJOB

To learn more about CMS, see *CMS at ANL* (ANL/TM 423, REVISION 1). To obtain an explanation of any CMS command, enter (in CMS):

    HELP commandname

where "commandname" is the name of the command in question. Entering **HELP** alone will give you information on additional topics for which online HELP is available.

The MVS Batch System

The IBM MVS (Multiple Virtual Storage) operating system provides batch computing. You communicate with MVS through job control language (JCL). MVS controls your job, as well as jobs submitted by other users. The operating system and Job Entry Subsystem 3 (JES3), another IBM system program, are responsible for allocating resources (memory, CPU, I/O devices, channels, disk storage, etc.) and for arbitrating when there is contention for a resource. JES3 handles job scheduling and general resource allocation.

We recommend the batch mode of operation when you are running jobs that need large amounts of resources (memory, tapes, disk storage, and CPU time). MVS batch provides a good environment for production jobs that have already been debugged. Batch computing is typically much less costly than interactive computing.

The following software is available in MVS batch:

- Programming languages, including Fortran (VS, H Extended, and G1 compilers), the PL/I Optimizing compiler, Assembler, and Cobol.

- The DFSORT file sorting and merging program.

- Graphics packages (including SAS/Graph and Disspla).

- The Waterloo Script text processing program.

- Libraries of mathematical software (including AMDLIB, IMSL, NAG, and DOE SLATEC).

- Statistical analysis packages (including BMDP, SPSS, and SAS).

- Source maintenance packages (including Librarian and Historian).

- The CSMP and THTB modeling programs.

- Several IBM and locally written utility programs.

To learn more about how to run jobs in MVS batch and how to create and manage MVS files, see *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1).

UNICOS and VAX cluster users will be enrolled in MVS batch (if they do not already have MVS accounts) when they get their UNICOS or VAX accounts. MVS batch will provide access to the UNICOS and VAX batch service and will perform UNICOS and VAX usage charge accounting.

All interactive services (CMS, VAX/VMS, Wylbur, and MVS TSO) provide the software necessary to submit jobs to the MVS batch system. For instructions and further information, refer to the manual for the service you are using.

The Wylbur Interactive Service

Wylbur (from On-Line Business Systems) serves as an interactive interface to the IBM MVS batch system. You will need to request authorization for Wylbur in addition to getting an MVS batch account. Wylbur runs on the "yellow" IBM 3033 computer. It provides the following major functions for MVS batch users:

• You can create and edit files with Wylbur's powerful yet easy-to-learn text editor in line-by-line or full screen mode.

• You can use Wylbur to submit and control MVS batch jobs (and UNICOS batch jobs).

• You can preview your output at your terminal before deciding to print (or purge) it.

• You can submit jobs to MVS batch that will manage data files (e.g., backing them up on tape, restoring them from tape to disk, renaming them, moving and copying them, and creating and managing libraries). You can also use Wylbur commands to do data management tasks.

We provide a library of locally written utility programs (public execs) to simplify data management in Wylbur.

MVS batch users should use Wylbur (1) to set up programs, JCL, and data; (2) to preview output before deciding whether to print that output; and (3) to perform routine data management tasks. Wylbur's quasi-English commands make using the MVS batch system more convenient.

The *SLAC Wylbur Tutorial* is a good introduction to Wylbur, and online HELP is also available. To get a list of all the Wylbur commands for which online HELP is available, enter (in Wylbur):

HELP

To get a list of all the locally written Wylbur execs for which online HELP is available, enter (in Wylbur):

HELP EXECS

To find out more about any Wylbur command or public exec, enter (in Wylbur):

HELP commandname

where "commandname" is the command about which you want information. Or enter (in Wylbur):

HELP execname

where "execname" is the exec about which you want information. To list other topics for which online HELP is available, enter (in Wylbur):

HELP TOPICS

Wylbur shares disk space only with MVS; however, simple procedures are available for transferring files to other services. For more information, enter (in Wylbur):

HELP SENDCMS

For information about Wylbur, see the *OBS Wylbur Reference Manual* and *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1).

The MVS TSO Interactive Service

The MVS Time Sharing Option (MVS TSO) is available on a limited basis primarily for users who run administrative programs that must have both interactive and batch access to the same files in MVS.

Users may apply for MVS TSO authorization by completing a brief MVS TSO enrollment form available from Account Services (Building 221, Room A-147, extension 2-5425). MVS TSO enrollment is subject to approval by CTD management; it is not automatic as with CMS, Wylbur, or MVS batch. As part of the enrollment process, we attempt to show you how you can do work more efficiently with services other than MVS TSO.

The CICS Interactive Service

The Customer Information Control System (CICS) is an interactive service used at Argonne for administrative applications, e.g., the Personnel Payroll System, the Medical System, the Integrated Financial System, and the Argonne Materials Order System, including the Materials CATalog (MCAT). CICS operates with MVS and is available to all users with MVS batch accounts. For information about CICS, see the *Reference Card for the Online Materials CATalog Through CICS, Network Access to CICS: Apple*

Macintosh, Network Access to CICS: Full Screen Terminal or ASCII Terminal, and *Network Access to CICS: IBM Personal Computer.*

The Central VAX Computers

The central VAX cluster at ANL currently consists of a VAX 8700 computer, a VAX-11/750 computer, a VAX 8250 computer, and a shared storage controller. The VAX 8700 computer is a general-purpose computer with hardware implementing all four VAX floating-point formats (F, D, G, and H). It is a byte-addressable virtual memory machine that provides programmers with a four-gigabyte programmable address space. The VAX 8700 computer has about six times the speed of a VAX-11/780 computer and has 32 megabytes of physical memory. (CTD plans to upgrade the memory of the VAX 8700 computer to 160 megabytes.) The VAX-11/750 computer (also called the "gateway VAX") functions primarily as a gateway to the Magnetic Fusion Energy network (MFEnet). The VAX 8250 computer is the VAX Supercomputer Gateway to the Cray X-MP/14. As a cluster, the VAX 8700 computer, the VAX 11/750 computer, and the VAX 8250 computer share a common file system through the cluster storage controller.

The central VAX computers use the Virtual Memory System (VMS) operating system,[4] which provides shared general-purpose interactive and batch computing services. The central VAX cluster is a node on each of the Laboratory-wide networks, including the TCP/IP network, DECnet, and the Network Job Entry (NJE) network.

Interactive access to the VAX cluster computers is available through computers and workstations on the TCP/IP or DECnet networks or through terminals that connect to the Argonne Private Branch Exchange (PBX) with modems or Asynchronous Data Interfaces (ADIs).

Software available on the VAX 8700 computer includes:

- Text editors (EDT, EVE, and LSE) for creating and modifying files in full screen mode.

- Programming languages (including Fortran, Basic, Pascal, C, and LISP).

- Program and source code maintenance tools (including the Code Management System and the Module Management System).

- A full screen symbolic debugger.

- The VAX Sort/Merge Utility.

- The Mass-11 word processing program.

- The TeX text formatting program with the DVITOVDU TeX previewer.

- DOE-MACSYMA Symbolic Algebra.

- Graphics packages, including Disspla, Tellagraf, Cuechart, Data Connection (which includes File Connection and Report Connection), and SAS/Graph.

- The SAS Statistical Package.

- Database and spreadsheet packages (including Datatrieve, Common Data Dictionary, and DECalc Plus).

- Mathematical libraries (including IMSL, NAG, and DOE SLATEC).

- The Bourne Shell Unix environment.

- VAX/NJE software for submitting MVS batch jobs and exchanging files with other systems in the NJE network and BITnet.

- Computer-based instruction on VMS, EDT, and EVE.

- BASIS Techlib library information management system.

To learn more about the VAX 8700 computer and the available VAX/VMS utilities, see *Using the Central VAX 8700 Computer at ANL* (ANL/TM 455, REVISION 1).

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[4] Throughout this document, the term "VAX/VMS" applies to the operating system running on the central VAX cluster computers. For information about divisional VAX computers and their available software, see your divisional VAX administrator.

The Intergraph 200 MicroVAX II Computer

The Intergraph 200 MicroVAX II is a customized DEC computer using the VAX/VMS operating system and Intergraph computer-aided design (CAD) application software. It serves as a host to Intergraph workstations distributed around the Laboratory that connect to the Intergraph 200 through the Laboratory-wide Ethernet. The Intergraph 200 is node ANLCAE on the Laboratory-wide DECnet and is accessible to all divisional DEC computers and personal computers that use the DECnet protocols. IBM personal computers (and compatibles) that run AutoCAD design software can exchange design files with the Intergraph 200 through DECnet.

Divisions and programs may purchase Intergraph design workstations for working with the Intergraph 200. The Engineering Division manages the CAD applications of the Intergraph system; call the Intergraph CAD Application Manager at extension 2-5317 for more information.

ADMINISTRATIVE COMPUTERS

Management Information Systems (MIS) in CTD operates three Hewlett-Packard 3000 minicomputers in Building 201 for the Automated Materials Payables System (AMPS), the Stock Tracker System (STS), and the Maintenance Control and Reporting System (MCRS). Access to these computers is limited (by hard-wired ports) to MIS analysts and to the users of these three applications. For more information, see "Administrative Systems" in Chapter 3.

RECORDED TELEPHONE MESSAGES

CTD's policy is to announce in advance all periods when systems will be unavailable because of scheduled maintenance.

Computer Operations maintains a 24-hour recorded message service describing the current system status. You can hear this recording by dialing extension 2-5466. These messages will report scheduled service interruptions, with estimated times when the unavailable services will be back online. If the system you are using does not respond to your commands, call the system status number to find out if the system is out of service. Allow five to ten minutes for Computer Operations to update the recorded message; if the message has not changed, call Computer Operations at extension 2-5421 to report your difficulty.

Users of the AMPS, STS, and MCRS administrative applications may call extension 2-8952 for a 24-hour recorded message describing the current system status of the Hewlett-Packard computers in Building 201.

NETWORK SERVICES

Through a variety of local network services and long-distance networks, Argonne computer users can communicate and exchange data with one another and with other computer users throughout the world. Offsite users may access the central Argonne computers through several of these networks or, in some instances, through standard telephone service (see "The Computer Callback Service for Offsite Users" in Chapter 2).

A network is a group of computers and peripherals connected so users can send information to one another or to various shared output devices. Networks can be local and involve only a few users, or they can be world-wide with thousands of connected computers. The computers and peripherals on a network use a network protocol to transmit information. Networks can be linked by gateways, which translate network protocols.

Electronic Mail

Users of CMS, Wylbur, Unix, and VAX/VMS can exchange electronic mail with one another; the mail systems originate, send, receive, file, and log electronic notes. In CMS, you can use the CMS mail system or PROFS (the Professional Office System). In Wylbur, you can use Wylbur commands for mail and file exchange. In VAX/VMS, you can use the DEC MAIL utility. In Unix, you can use the MAIL command. Users of CMS, Wylbur, and VAX/VMS can also exchange mail with other onsite computers (including divisional VAXes and some divisional NBI systems) through the Laboratory-wide TCP/IP network and the Laboratory-wide NJE network. All of the computers connected to the Laboratory-wide TCP/IP network and the Laboratory-wide NJE network can, in turn, communicate with computers on BITnet, Internet, and other world-wide networks. To send electronic mail, you need to know the recipient's electronic mail address (user ID and node name).

You can find the electronic mail address of Argonne employees in the *Argonne Directory* or by using the ANLPHONE exec in CMS, Wylbur, or

VAX/VMS. To find the entry for the employee about whom you want information, enter:

        ANLPHONE lastname

where "lastname" is all or part of a last name or a last name plus a space and all or part of a first name; the exec will locate entries in the **ANLPHONE** database that match what you entered.

To add your electronic mail address to the Personnel database and **ANLPHONE,** give the information to your HRS divisional personnel representative. To find out who your divisional personnel representative is, contact your division office. The format of the electronic mail address that you give to your HRS divisional personnel representative is *userid@nodename,* where "userid" is the name that identifies your account to the computer and "nodename" identifies the computer system that you use.

For more information on using electronic mail, see *Electronic Mail at ANL* (ANL/TM 431, REVISION 2).

Voice and Data Communication

The PBX is a communications network that allows simultaneous voice and data transmission. Thus, the PBX serves Argonne's needs for both telephone service and computing communication. The PBX provides many options for data communication among terminals, workstations, and computers.

To take advantage of the PBX capabilities for high-speed transmission and simultaneous voice and data communication, onsite users can connect terminals to computers through an Asynchronous Data Interface (ADI) 100, an Asynchronous Communication Interface (ACI) 100, or a data interface on a PBX data line rather than through a modem on an analog (regular telephone) line. Onsite users can also have the Machine Keyboard Originate (MKO) option installed on their data lines; this option allows dialing telephone numbers through the terminal keyboard. To request PBX data communications service or the MKO option, see your divisional telephone coordinator. To report a telephone-related difficulty, call extension 2-4400. For more information, see the *Asynchronous Data Communications User Guide with ADI/ACI 100 Operating Instructions* (ANL/TM 469).

Local Area Networks

A local area network (LAN) is a high-speed communications system designed mainly to connect computers within small work groups in the same physical area. Computers connected to LANs can still execute tasks independently, but LANs allow users to share resources (e.g., printers, disks, and communications servers) that allow access to computer systems and networks outside the LAN.

Devices on a LAN use a network protocol (or shared network language) to communicate with each other. Some of the common protocols at Argonne are TCP/IP, DECnet, and various personal computer network protocols. Networks using these protocols can communicate simultaneously through the Laboratory-wide Ethernet.

The Argonne Laboratory-Wide Ethernet

The Laboratory-wide Ethernet connects the central Argonne computers with many LANs distributed around the Laboratory through the PBX LANmark feature. Ethernet interfaces to LANmark are available for individual Ethernet devices (e.g., DEC MicroVAX, IBM Personal Computer, and Sun Workstation) and for bridging existing cable-based Ethernet networks. LANs and devices in the Laboratory-wide Ethernet communicate through the Digital Equipment Corporation network (DECnet), the TCP/IP network, XNS, or other protocols; however, devices or networks using different protocols cannot communicate with each other. Many Argonne computers using these protocols communicate through the Laboratory-wide Ethernet.

The Argonne Laboratory-Wide TCP/IP Network

TCP/IP is a widely adopted standard set of protocols defined by the Department of Defense for the communication and interconnection of differing computer systems. Users communicating through TCP/IP networks can send files, exchange mail, and logon interactively to services on remote computers. CTD uses TCP/IP protocols on the central VAX computers and CMS and on the Sun-3/280 gateway to the Cray X-MP/14 computer. Users of Sun, IBM, or Apple Macintosh personal computers can connect to any central computer via the Laboratory-wide TCP/IP network.

The Argonne Laboratory-Wide DECnet Network

Many of Argonne's divisional DEC computers (VAXes, PDP-11s, and MicroVAXes), as well as the central VAX computers, are connected to the Laboratory-wide DECnet, which uses DEC's protocol. VAXes and MicroVAXes that run the VMS operating system can access the central IBM computers, BITnet, and other networks available through the Laboratory-wide NJE network. Many divisional LANs also connect to DECnet.

Personal Computer LANs

Many divisional LANs use 3Com products to connect personal computers, printers, and other peripherals. The 3Com devices use the the Xerox Network System (XNS) protocol. (LANs linking Apple Macintoshes often use the AppleTalk protocol, which can be bridged over the Laboratory-wide Ethernet.) Personal computers attached to XNS LANs can connect to the central IBM computers through communications servers. These LANs can also be connected to each other and to the central Argonne computers through the Laboratory-wide Ethernet. For assistance in planning, selecting, and installing LANs, call Linda Winkler at extension 2-7236.

Services are available from the Electronics Department for the maintenance and installation of computer-based LANs and network servers. Networks supported include Ethernet-based networks (3Com, IBM Personal Computer, DEC, and Unix) and LocalTalk-based networks (Apple and IBM personal computers). Electronics stocks a wide variety of hardware from Ethernet cables, transceivers, and repeaters to LocalTalk cables, connector kits, repeaters, and interface cards. On request, Electronics can quickly make custom cables. For information, call extension 2-6969.

The Argonne Laboratory-Wide NJE Network

Argonne has established a computer-to-computer Laboratory-wide NJE network (see Figure 2) through which users on the central Argonne computers, on most divisional VAXes, and on some divisional NBI systems can transmit data to other users, computers, and remote output devices. The Laboratory-wide NJE network allows Argonne computer users to communicate with the computers on the BITnet university network. These network connections allow both file transfer and electronic mail.

Wide-Area Networks

Users outside the Chicago area can access any of Argonne's central computer interactive services (i.e., CMS, VAX/VMS, MVS TSO, and Wylbur) through either the Tymnet network or the Internet data communications network. The rates on either of these networks are usually lower than commercial long-distance telephone rates. The Internet network also provides Argonne researchers with a communications link to several hundred computer systems located throughout the United States and in some foreign countries. Outside users can exchange mail with Argonne computer users through Tymnet, Internet, BITnet, MFEnet, ESnet, and CHUBnet (see Figure 3).

Tymnet

World-wide access to Argonne's central computer interactive services (UNICOS, CMS, Wylbur, VAX/VMS, and MVS TSO), as well as to other Argonne computers, is available through the Tymnet commercial network. CTD has installed Tymnet to make collaborations easier, to provide access for Argonne users during travel, and to serve other offsite users who are sharing resources. TYMUSA is a Tymnet service that allows Argonne users and collaborators to connect to Argonne computers from 27 international locations. You can use Tymnet with asynchronous terminals at speeds from 300 to 2400 bps (bits per second), and you can access Argonne by calling the closest local Tymnet area office. *Tymnet Access Locations* provides a list of access locations in the U.S. and foreign countries. *How To Use Tymnet Asynchronous Access* (NUD-118USE) describes logon procedures.

There is an hourly connect time charge for Tymnet. You must obtain a Tymnet password to access Argonne computers via Tymnet. You must also have a valid Argonne computing account for the interactive system you plan to use. To make the necessary arrangements, contact Account Services at extension 2-5425.
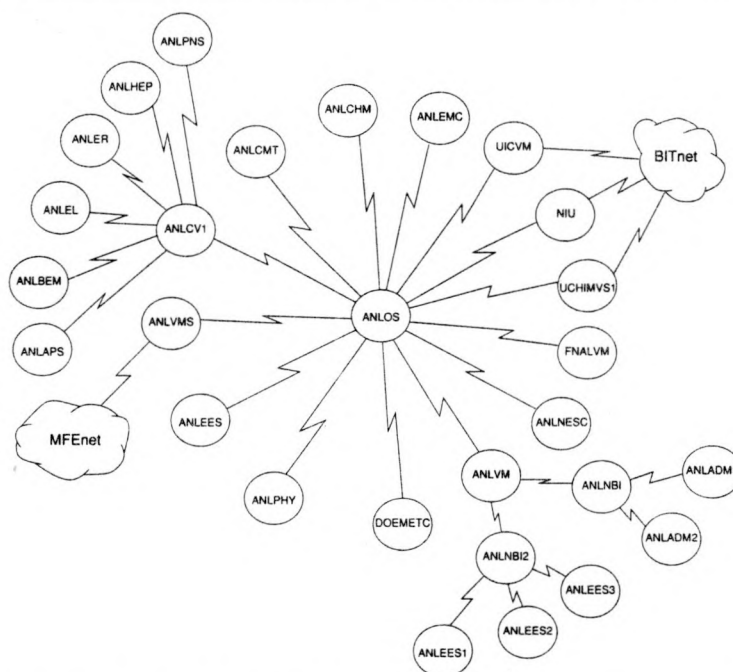
Figure 2: **The Laboratory-Wide NJE Network (January 1990)**

Internet

Argonne is connected to Internet, a nationwide data communications network that allows geographically separated users to communicate and share resources by using TCP/IP. Through Internet, Argonne users can communicate with over 80,000 computer systems around the world. Internet also offers file transfer capabilities.

BITnet

The IBM and VAX computers that comprise the Laboratory-wide NJE network are connected to a world-wide university computer network called BITnet. BITnet uses the same protocol as the networking for the Argonne VAX NJE software, for JES3 NJE, and for the VM Remote Spooling Communications Subsystem (RSCS). This connection allows for enhanced collaborations among Argonne scientists and scientists at universities and other research institutions on BITnet. You can use BITnet to share programs and data with other BITnet users and to communicate with them through electronic mail. For general information about BITnet, enter (in CMS, the VAX 8700, or MVS Wylbur):

HELP BITNET

For a current list of computer systems connected to the BITnet network, enter (in CMS, the VAX 8700, or MVS Wylbur):

HELP BITNET NODES

Argonne users of the IBM or VAX computers on the Laboratory-wide NJE network can send mail to recipients on BITnet with the same commands they use to send mail on the Argonne NJE network. However, to send mail, you must know the electronic mail address of the recipient (i.e., userid and nodename); you should be reasonably certain that the recipient reads electronic mail regularly. Many electronic mail correspondents exchange electronic mail addresses by telephone before making the first attempt to communicate through electronic mail.

Figure 3: **Universe Available to Argonne Users for Electronic Mail**
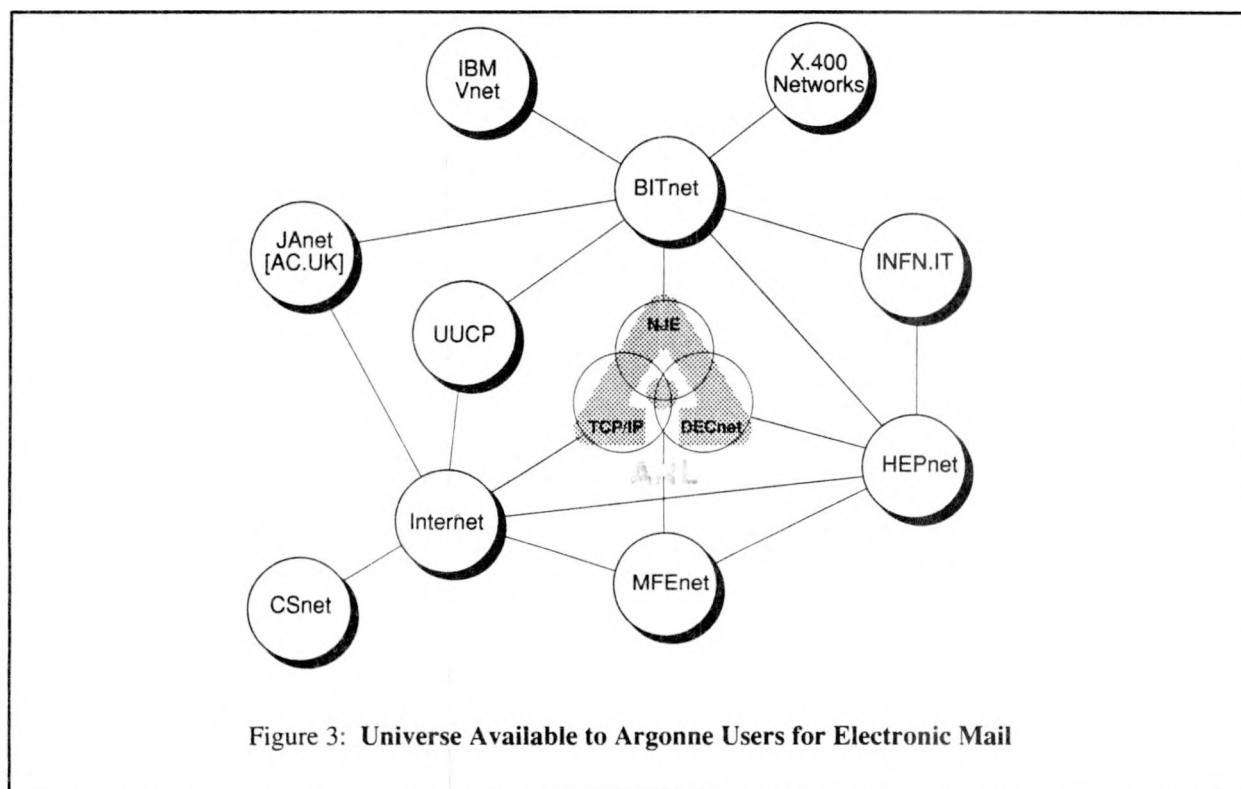
MFEnet

MFEnet allows researchers to access supercomputers (e.g., the Cray computers at the National Energy Research Supercomputing Center[5] in Livermore, California). MFEnet is being decommissioned in FY1990 and is being replaced by ESnet.

ESnet

The DOE Office of Energy Research (OER) under the management of the OER Scientific Computing staff has initiated a new effort in data communications networking designated the Energy Sciences network (ESnet). The ESnet concept is intended to bring together the various data communication efforts of the different research programs funded by OER (e.g., Energy Research, Fusion Power, and High Energy Physics) into a single network that would use protocols being developed by the International Standards Organization (ISO) for Open Systems Interconnect (OSI). A phased implementation of ESnet is now under way.

ANL is currently connected to ESnet. ESnet provides dual protocols: TCP/IP and DECnet gateways. ESnet will serve as the backbone of the High Energy Physics network (HEPnet) and will provide gateways to the Internet. Major ESnet nodes are connected with a T1 (1.54 megabits per second) backbone network. Argonne has a T1 connection to Fermi National Accelerator Laboratory, the Princeton Plasma Physics Laboratory, and Oak Ridge National Laboratory.

At Argonne, software has been installed on the CTD VAX 8700 and the CMT VAX 6250 computers, allowing Argonne users access to the Livermore Crays via MFEnet II. During FY1990, we will migrate MFEnet II to ESnet.

CHUBnet

Argonne is connected to the University of Illinois at Chicago and thus to the Chicago HUB network (CHUBnet) with T1 service. CHUBnet includes Argonne, the University of Illinois at Chicago, the University of Chicago, the University of Illinois at Urbana-Champaign, Northwestern University, the Illinois Institute of Technology, the University of Notre Dame, and Fermi National Accelerator Laboratory (FNAL). The link between Argonne and the University of Illinois at

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[5] Formerly called the National Magnetic Fusion Energy Computer Center.

Chicago is capable of simultaneous transfer of TCP/IP and DECnet data packets.

CICnet

The Consortium for Institutional Cooperation network (CICnet) provides T1 links to the University of Wisconsin, Michigan State University, the University of Michigan, Ohio State University, the University of Minnesota, Indiana University, the University of Iowa, Northwestern University, the University of Chicago, the University of Illinois at Chicago, and the University of Illinois at Urbana-Champaign. The CHUBnet/CICnet backbone is connected via T1 links to the University of Illinois at Urbana-Champaign (the university network and the National Center for Supercomputing Applications [NCSA]).

NSFnet

The National Science Foundation network (NSFnet) connects to the regional network at both the University of Illinois at Urbana-Champaign and the University of Michigan at T1 speeds. Argonne researchers can use the DECnet protocol in their scientific collaborations with regional institutions.

UUCP

The Unix-to-Unix Copy Protocol (UUCP) is a transport mechanism over which mail and files are transmitted. It is a dial-up network; each machine on the network periodically dials up other machines to send and receive accumulated mail and files. Since UUCP has no well-defined topology, you must know the complete UUCP path (from the originating node, through intermediate nodes, to the destination node) to send mail. However, there are some nodes that frequently dial many other computers, so the path lengths are not usually very long.

Gateways are available to exchange mail between BITnet and UUCP. For more information on UUCP, see *Electronic Mail at ANL* (ANL/TM 431, REVISION 2).

ANL Computer Networks and Data Security

Most computers are now connected to one or more computer networks. These connections permit computer users to transfer information to each other, even though they may have accounts on separate computers. Each computer has its own operating system security features to protect the operating system itself and to authorize logon access and sharing of data (although these security features may be minimal for personal computers). Multi-user computer operating systems normally require the use of authorized user identification and password combinations before allowing a user to access the computer.

Operating system protection does not generally extend beyond the computers themselves; where networks are used to access the computers, the networks may not be secure. For most LANs, it is possible for anyone having physical access to a computer on the network and network monitoring software to monitor data transmissions. By using a personal computer with such software, an unscrupulous person can identify and trap user identification and password combinations or other data transmitted through the network.

ANL networks include LANs (or groups of LANs) within a building. These LANs are then connected by a gateway (an LDI-410), which is part of the PBX, to the Laboratory-wide Ethernet (LANmark). Messages generated by one computer in a LAN with destinations in that same LAN do not enter the Laboratory-wide Ethernet; they remain local. Messages destined for the central computers in Building 221 are routed through the PBX to the computer room LAN.

For planning purposes, you can assume that security of data on the PBX Ethernet and on the Building 221 computer room Ethernet is adequate for sensitive (but not classified) data (that is, transmissions are confined to the computer room and a single LAN connected to the PBX).

If you plan to use a LAN to transmit sensitive data, you must include in your risk assessment and protection plan a discussion of the risks of using a LAN, any precautions you take to mitigate those risks, and a statement explaining why you believe any remaining risks are acceptable.

THE ACRF COMPUTERS

The Mathematics and Computer Science (MCS) Division operates the ACRF. The ACRF was established in 1984 to study parallel computer architectures and their role in scientific computing.

The ACRF consists of several multiprocessor computers: an Alliant FX/8, an Encore Multimax, an Intel iPSC-VX/d4 four-dimensional hypercube system, an Intel iPSC/d5 five-dimensional hypercube system, a Sequent Balance 21000, an Active Memory Technology Distributed Array Processor-510 (AMT DAP-510), a Thinking Machines Connection Machine Model 2, an Ardent Titan graphics supercomputer, a Sequent Symmetry, a BBN Butterfly TC2000, and a BBN GP1000.

Since the ACRF computers connect to the Argonne TCP/IP network, ACRF users can access graphics output equipment, tape drives, and mass storage devices available through the central Argonne computers. All parallel computers are linked in a single LAN.

Those interested in using the parallel computers in the ACRF may submit a proposal to the Scientific Director of the ACRF. This proposal must include a description of your research problem, an estimate of how much computer time you need, an explanation of how you will access the ACRF, and a mention of which multiprocessor you would like to use. MCS will review the proposal. To obtain a proposal form, send electronic mail to `huml@mcs.anl.gov` or call extension 2-7163.

Periodically, MCS offers three-day classes on using the ACRF. These classes cover how to apply parallel programming concepts. For information about these classes and the use of ACRF facilities, contact MCS at extension 2-7163 or come to Building 203, Room C-241.

THE OFFSITE HIGH-PERFORMANCE COMPUTERS

Several high-performance computer sites are accessible to ANL researchers via the Internet and ESnet computer networks. Researchers funded by the DOE OER may be eligible for allocations of Cray resources at the National Energy Research Supercomputing Center in Livermore, California, or at the Florida State Supercomputer Center in Tallahassee, Florida.

Each year the DOE Office of Basic Energy Sciences (BES) sends a call for proposals to scientists who are working on BES-sponsored research. BES then reviews the proposals and allocates time on these computers. For information on authorization to use BES-funded computers, contact BES's Office of Scientific Computing at FTS 233-5800.

Researchers may also submit proposals to the National Science Foundation (NSF) for supercomputer resources at NCSA in Urbana, Illinois; the Ohio State Supercomputer Center in Columbus, Ohio; and other NSF supercomputer sites.

THE DISTRIBUTED DEC VAX COMPUTERS

Several DEC VAX computers distributed throughout the Laboratory complement the Argonne central computing services. Individual divisions or other organizations own and operate these computers. CTD provides network communications services for distributed VAX computers for a monthly charge. These services include establishing the communications link between the division system and the central computers, assisting with the coordination of available services, maintaining the device-independent graphics and communications packages, assisting with telecommunications, and providing consulting advice.

Most of these computers are nodes on the Argonne Laboratory-wide NJE network (see "The Argonne Laboratory-Wide NJE Network" above). Users of the computers on the Laboratory-wide NJE network can submit jobs and transfer files and electronic mail to and from any other node on the network and to nodes on BITnet. To learn more about this network, see *Electronic Mail at ANL* (ANL/TM 431, REVISION 2).

CTD's VAX software distribution kit sharing procedure provides online network access to many DEC VAX/VMS product distribution kits from remote VAXes and VAXstations. CTD maintains current release level distribution software for VAX products on the central VAX cluster. VMS product distribution kits are available only for systems with valid VMS software product licenses. Users who have purchased DEC right-to-copy update service for a product for their VAX or VAXstation may also access VMS distribution kits. To obtain access to a distribution kit, contact the CTD Software Librarian (Building 221, Room B-220, extension 2-8403).

Many divisions have DEC VAX and VAXstation computers running the VMS operating system. Electronics provides consulting and programming support, system management support, and maintenance services for users of these systems. Electronics has a VAXcluster for development work and programming support of real-time data acquisition and control systems.

PERSONAL COMPUTER ENVIRONMENT AT ANL

Personal computers are a viable option for a wide variety of applications. Word processing, spreadsheet, presentation graphics, and database software packages are commonly used on personal computers. Because of their small size, low cost, increased computing power, and availability, their use has become commonplace throughout the Laboratory. You can use personal computers in a standalone environment, as a node on a LAN, or as a terminal to access central computers.

At ANL, personal computer populations consist primarily of the IBM PC, the IBM PC-XT, the IBM PC-AT, and the IBM PS/2 and compatibles, in addition to the Apple Macintosh computer systems.

Much care should be taken in the selection of applications software to ensure compatibility with systems used by co-workers and collaborators and with services provided at the Laboratory. In general, it is a good idea to use the same word processing package, spreadsheet, etc. as those with whom you must interchange files and data.

Education and assistance for personal computer software packages should not be overlooked in the selection of a personal computer. A large investment of time and money is spent on transforming a new personal computer user to a productive user. Many local vendors provide excellent training classes in most of the widely used software packages. Additionally, many software packages come equipped with an online self-paced tutorial that can introduce a new user to the package. Additional assistance is available from CTD for select software packages, and hardware maintenance is available from Electronics.

Some standards have become widely accepted and enable hardware and software from multiple vendors to work together in an integrated fashion. For example, most word processing programs and many graphics programs create documents for laser printers that use the PostScript page description language. The use of standards is especially important when using a LAN. Some vendors provide network versions of applications software that when shared by multiple users standardize on the same version of that product and avoid incompatibilities between different versions. Not all vendors have LAN versions of their products available. Additionally, products that do have network versions (such as Ashton Tate's DBase) require users to revise or modify applications to take advantage of the network features.

When using a personal computer, you are responsible for backing up your own data. You should back up important files on more than one disk and store the back-up disks in a location different from the personal computer. Also, the protection available for data stored on personal computer disks is generally not as sophisticated as the protection on the central computing systems. You should not store sensitive data on a personal computer unless you are certain that the data is sufficiently protected on the computer and in any networks through which the data passes. Though storing your central computer user verification password in a personal computer file may be convenient (i.e., for automatically logging on when dialing a service on the central computers), doing so involves risks; someone may discover your password, especially if other people have access to your personal computer or your file system.

An unfortunate aspect of the freedom afforded by personal computers and workstations and the sharing of data via diskettes or networks is that it is not difficult nor uncommon for an undesired computer virus to contaminate or damage programs or data on your system.

You need to prevent infection by a computer virus. If you run only legal copies of commercial software, you can minimize these risks. Write protect your original software diskettes, then (where license agreements permit) make a copy. Keep the original in case your copy is damaged or infected by a virus.

If you need to use public domain software, make sure your hard disk is backed up and have on hand virus detection and eradication software.

Never use any software you receive from an unknown source.

ANL has organized virus fighting teams to identify virus attacks, to inform the user population of the detection and eradication of potential viruses, and to assist in recovering from a virus attack. For further

information, call the ANL Computer Protection Program Manager, Jean Troyer, at extension 2-7440.

There are several users groups that are open to new and experienced users. The Macintosh Users Group, the Argonne Personal Computer Club, and the 3Com Administrators Group can be invaluable sources for information. For more information about these groups, see Table 12.

You can use IBM PCs and Apple Macintoshes to communicate with other computer systems by using terminal emulation software. On some personal computers, communications hardware is standard equipment. Most personal computers are equipped with RS-232 ports for connecting to modems, ADIs, etc. However, most personal computers require additional optional hardware for connecting to Ethernet (see "Accessing Central Computers with Terminals and Workstations" in Chapter 2).

Local area networking is a necessity for sharing work among co-workers at the Laboratory. Many IBM PCs have been equipped with Ethernet cards enabling them to participate in the Laboratory-wide Ethernet. There are over a dozen 3Com LANs that enable divisional work groups to share data and printers.

Many Apple Macintoshes have been equipped with Ethernet cards or with AppleTalk connections enabling them to participate in the Laboratory-wide AppleTalk network.

One of the benefits of networking personal computers is the ability to participate in electronic mail. At the present time, the most reliable method for communicating with electronic mail is to have an account on a mainframe, minicomputer, or Sun Workstation. Quick Mail for Apple Macintosh users is increasing in use; however, at this time, several technical issues need to be resolved before it is a totally reliable alternative. CTD is investigating the integration of 3Com mail with standard mail protocols used at the Laboratory.

Electronics designs custom systems by using high-performance disks and fast CPUs that meet special requirements for data acquisition, data reduction, and file server applications. For information on compatibility and maintenance of planned systems and system upgrades, call extension 2-6969.

AlisaShare File Server for Apple Macintosh

AlisaShare lets you use disk space on the central VAX cluster as though it were another Apple Macintosh disk. You can create files and folders on the AlisaShare disk, perform copy operations between a local disk and your AlisaShare disk, and launch (i.e., run) applications from your AlisaShare disk. CTD backs up the AlisaShare disk space weekly and performs daily incremental back-ups.

The amount of file server space available to your Apple Macintosh is limited only by the amount of space available to the central VAX cluster. You can create a file on the Cray X-MP/14 or on the VAX 8700 computer and place it in your AlisaShare file server space where it would be available to you from your Apple Macintosh. Conversely, you can move files from the Apple Macintosh to your file server space and access them from the VAX 8700 computer. Since file formats and attributes are different between the Apple Macintosh and the VAX, the use of a file created on the other system may not be automatic and may need some conversion.

To become an AlisaShare file server user, you need an account on the central VAX cluster. However, Apple Macintosh users need not log into the VAX to use their AlisaShare disks. Obtain a "Computing and Telecommunications Division Request for Authorization of Computer Account" form (available from Account Services, Building 221, Room A-147) and check "VAX/VMS" and "AlisaShare" as the services requested.

Also, you need Apple's AppleShare Version 2.0 or later installed in your Apple Macintosh system folder and access to the Laboratory-wide AppleTalk network.

Several additional files that you may want to use are on the AlisaShare read-only Public Volume in AppleTalk zone Public AlisaTalk. This disk includes the latest copies of Apple's LaserWriter and LaserPrep files (Version 6.0), Telnet from NCSA, NCSAImage, and a virus disinfectant program.

CTD has established the AlisaTalk Public Volume as a prototype distribution mechanism for software in the public domain that CTD recommends and for which CTD intends to provide assistance. The Public Volume is not intended to be used as a disk from which to launch applications. The AlisaShare volume and AlisaShare file server software has a

limited capacity for handling file server requests. At this time, we have no plans to monitor or increase allocated resources to optimize response for AlisaShare. Instead, we expect that users will copy available software to run on their own computers. The virus disinfectant program is an exception. However, it may be desirable to launch the virus disinfectant program from the Public Volume to ensure that it cannot be infected by a virus in your system.

It is also possible for your cost center to create its own AlisaShare file server group disk to share data among all of the group's Apple Macintosh users. To establish a cost center AlisaShare disk, your division director will need to appoint a group manager to manage the central VAX cluster environment for your cost center's users.

Maintenance Services

The Electronics Department offers the following services for a variety of Laboratory-owned personal computers (see Table 1):

- Installation and maintenance of new personal computer systems (Apple Macintosh, Compaq, IBM, IBM compatibles, Sun, and NeXT).

- Installation and maintenance of disk drives, monitors, printers, and laser printers.

- Installation and maintenance of computer networks and file servers. Electronics stocks cable and network components for Ethernet, LocalTalk, and 3Com.

- Assistance with systems under warranty.

- Upgrades. Electronics stocks upgrades for all systems maintained (including additional memory, hard disks, and peripherals). For some systems, Electronics also stocks performance improving hardware.

- Parts. Electronics stocks many computer cables (including custom-made cables).

- Electronics subscribes to several services to assist in maintenance plans (Sun, DEC, IBM, Apple, and NeXT).

For more information on computer installations, maintenance, fixed price contract maintenance, and custom configurations, call extension 2-6969.

Table 1

Personal Computers Maintained by Electronics

Apple Computer	DEC
Macintosh 128/512	VS 32/35/3600
Macintosh Plus	MV 32/35/3600
Macintosh SE	VS 2000
Macintosh SE/30	MVII
Macintosh II	VSII/GPX
Macintosh IIx	
Macintosh IIcx	

Compaq	Sun
Deskpro 286	3/50
Deskpro 386	3/60
	3/80
NeXT	3/140
	3/280
Cube	

International Business Machines

IBM PC-XT
IBM PC-AT
IBM PS2/30
IBM PS2/30-286
IBM PS2/50
IBM PS/2 50Z
IBM PS/2 60
IBM PS/2 70
IBM PS/2 80

Computing Workstation, Equipment, Software, and Peripherals Acquisition Procedure

Computing workstations, equipment, software, and peripherals that cost less than $1,000 are approved at the discretion of the individual Division Director or Department Manager. Computing workstations, equipment, software, and peripherals that cost $1,000 or more require a "Computing Workstation, Equipment, Software, and Peripherals Acquisition Justification" (ANL-489) attached to a "Purchase Requisition" (ANL-451) and submitted to your Division Director or Department Manager for approval. See *ANL Statement of Site Strategy for Computing Workstations* (ANL/TM 458, REVISION 2).

Employee Responsibilities for Complying with Software Licenses

Laboratory policy and DOE policy prohibit the unauthorized duplication and use of computer software. A Laboratory policy memo on "Employee Responsibilities for Complying with Software License" (dated November 23, 1988, and sent to all employees from the ANL Chief Operations Officer) states:

> As you are aware, the unauthorized duplication and use of computer software is contrary to Laboratory and DOE policy and violates the U.S. Copyright Law. Unless otherwise specified in a license agreement, the funds used to purchase a software product represent a license fee for the use of one copy of the software product. Should the software be reproduced or duplicated without authorization, then the U.S. Copyright Law has been violated, making the infringement a Federal offense. Civil damages for unauthorized software copying can be as much as $50,000, and additional criminal penalties such as fines and imprisonment can be imposed.

Check to be sure any use you make of software complies with the terms and conditions imposed by the vendor.

NBI OASYS OFFICE AUTOMATION SYSTEMS

Several Argonne divisions have NBI office automation and word processing systems. In general, each system consists of an NBI OASys 64 Integrated Communications Unit (ICU) connected to NBI 2000 and NBI 4000 workstations and to local printers. These NBI systems provide word processing and personal computing functions and can provide American Standard Code for Information Interchange (ASCII) terminal emulation. The divisions that own NBI systems enroll division members who need to use these resources.

File transfer and mail exchange are possible between some of Argonne's NBI systems and the Laboratory-wide NJE network and BITnet. This capa-bility is an extension of the NBI OASys mail utility, which provides electronic mail service among users on an NBI system. For information on exchanging data between the Laboratory-wide NJE network and a linked NBI system, see *NJE Enhancements to NBI OASys Mail* (ANL/TM 451).

OUTPUT DEVICES

There are various types of output devices (e.g., terminals and printers) distributed around the Laboratory. This section will describe these output devices briefly but will only go into detail on those output devices available (unless otherwise indicated) in Building 221.

Terminals

Many different types and brands of terminals are in use at Argonne; there are ASCII (line-by-line) terminals, full screen terminals, personal computers, and scientific and engineering workstations. (Personal computers and workstations can also operate as terminals. For terminal descriptions and the appropriate terminal settings for connecting to one of the central computing services, see *Asynchronous Data Communications User Guide with ADI/ACI 100 Operating Instructions* (ANL/TM 469). You can use a terminal connected to one of the central Argonne computers to communicate with an interactive service or to view program output from a batch job. If you are creating graphics, you need a graphics terminal or scientific workstation to view your output and to debug your graphics program. For terminal recommendations, see "Accessing Central Computers with Terminals and Workstations" in Chapter 2.

Printers

There is a wide variety of printers available at Argonne. Most remote stations (stations connected by a data link rather than by a direct channel) have line printers that will print jobs sent from or routed to those stations. The Apple LaserWriter is a popular PostScript printer; many of these printers are distributed around the Laboratory. A high-resolution typesetter, the Linotype L300P, is a PostScript printer available in Graphic Arts for professional quality print production. Printing devices in the central computing complex (Building 221) include high-speed impact line printers and a high-speed high-volume non-impact

printer. A laser printer is available in Building 201 for administrative purposes.

Postscript Printers

The Apple LaserWriter is a PostScript printer that produces good quality print (a resolution of 300 dots per inch) that is satisfactory for letters, memos, and any other communication that might otherwise be typed. It is also appropriate for printing draft copies of documents, and even camera-ready print copies for internal documents. The Apple LaserWriter is compatible with Waterloo Script-produced text and graphics software packages (e.g., Cuechart, Tellagraf, Disspla, and SAS/Graph). For specific information on using the Apple LaserWriter, see *Using the Apple LaserWriter at ANL* (ANL/TM 452).

Linotype L300P Typesetter

The Linotype L300P typesetter in Graphic Arts (Building 222) produces high quality (a resolution of either 1,240 or 2,480 dots per inch) output of text and gray-scale graphics that is ideal for camera-ready print copy. The Linotype L300P is, like the Apple LaserWriter, a PostScript printer; applications that print on the Apple LaserWriter will print on the L300P. However, the typesetter is not a high-volume output device; you should use it only to produce final, camera-ready copy for printing. Use an Apple LaserWriter or other PostScript printer for draft and proof copies. If you would like to use the L300P typesetter, call Graphic Arts at extension 2-5603 to discuss your printing needs.

Impact Line Printers

The high-speed impact line printers in Building 221 can print output from any of the central computer services.[6] These printers can print a maximum of 132 characters per line, 10 characters per inch at 20 or more pages per minute. The standard page is 14 inches wide by 11 inches high. Line spacings of 6 (standard) and 8 lines per inch are available. The TN print character set is available (which includes uppercase and lowercase alphabetic characters, numbers, numeric superscripts, and punctuation symbols required for text and pro-

gramming); the PN print character set is standard and lacks the lowercase alphabetic and superscript characters present on the TN train. Special forms, labels, and several carriage control formats are available. For customized printing jobs, call the User Services consultants at extension 2-5405 to determine if your needs can be met. For more information on the hardware characteristics of the central impact line printer, see *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1).

Non-Impact Printer

The high-volume high-speed non-impact IBM 3800 laser printer in Building 221 produces output on 8.5-by-11 inch fanfold paper, with up to 150 characters per line, 15 characters per inch, and 60 lines per page. The printer prints a page at a time at the rate of 100 or more pages per minute. It prints the TN character set described above. If you need other character sets or special pre-printed form type imagery, contact the User Services consultants at extension 2-5405 to determine if your needs can be met.

Microfiche Printer

The microfiche printer in Building 221 produces 4-by-6 inch film sheets that contain 288 frames each; each frame is a standard printer-compatible six lines-per-inch printed page reduced by a factor of 48. The microfiche printer prints the TN train character set. Microfiche is a good medium for storing large files of printed output; you can read the film and reproduce it on paper with desktop viewers and printers located in most divisional libraries throughout the Laboratory. For more information, see *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1).

Administrative Laser Printer

The Hewlett-Packard 2680 laser printer in Building 201 produces output on 8.5-by-11 inch fanfold paper. The Hewlett-Packard 2680 is a moderate speed printer used by administrative systems.

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[6] CTD plans to replace all IBM 1403 Model 1 line printers with a faster model line printer.

Graphics Devices

CalComp Color Plotter

The CalComp 5835 XP electrostatic color plotter in Building 221 will do large format color graphics on 36-inch continuous paper and is capable of printing in 1,024 colors. It is suitable for multicolored maps, engineering diagrams, posters, and any other diagrams requiring a large (or small) format, intense detail, area shading, and color hues. The CalComp is compatible with all Computer Associates (CA) graphics products (e.g., Cuechart, Tellagraf, Disspla, and SAS/Graph), many personal computer packages (e.g., SuperImage), and the Ezpert project management package.

Matrix Camera

The Matrix camera in Building 221 produces high-quality 35mm color slides. There are a variety of film format options available on the Matrix camera: 35mm positive (default), 35mm negative, or viewgraph (8-by-10 inch transparency film for use with overhead projectors). Negative 35mm film is necessary for making positive prints. Full-frame color slides are standard. Black-and-white slides are optional.

Chapter 6 describes some other graphics output devices.

GRAPHIC ARTS: POSTSCRIPT OUTPUT DEVICES AND APPLE MACINTOSH-BASED SERVICES

Graphic Arts uses Apple Macintosh-based computer products for both composition and presentation work. Graphic Arts has various models of Apple Macintoshes and software (e.g., Aldus Persuasion and Aldus PageMaker, Expressionist and MathType, MacDraw II and Canvas, DeltaGraph and ImageStudio, Adobe Illustrator and Aldus Freehand, and about 140 Adobe PostScript type fonts).

There are three ways to get documents and publications typeset in Graphic Arts:

1. Full-Service: Give Graphic Arts a manuscript to design, keyboard, draw, and lay out.

2. Value-Added Service: Give Graphic Arts a partially completed job (send most of the figures and an ASCII file of approved text for layout).

3. Self-Service: Send a PostScript file directly to the Linotype L300P Imagesetter (see below).

Graphic Arts maintains three PostScript output devices for the Laboratory:

1. QMS ColorScript 100 Model 30 color printer: 8.5-by-11 inch or 11-by-17 inch paper or transparency.

2. QMS 2200 11-by-17 inch laser printer.

3. Linotype L300 high-resolution (1270 dots per inch) Imagesetter.

These output devices are available to Apple Macintosh users with a connection to the Laboratory-wide Ethernet via Chooser Zone Public AlisaTalk via QuickMail (as an enclosed file) or from an Apple Macintosh disk. The file can be a document (if we have the application) or a PostScript file. To users of other computer systems, these devices are available via AlisaTalk queues on the central VAX cluster. Graphic Arts can also print from a PostScript file on a personal computer disk.

Graphic Arts has an Apple Macintosh-based film recorder that can produce output from presentation programs (Aldus Persuasion, Microsoft PowerPoint, and Cricket Presents) and from PICT files.

For more information, contact Lee Wagar (Graphic Arts) at extension 2-5603.

CHAPTER 2

GETTING STARTED

Before you begin using central computers at Argonne, you will need to establish a computer account and become aware of Argonne's computing policies and procedures. This chapter covers these policies and procedures and describes some computer user conveniences.

ESTABLISHING AN ACCOUNT ON THE CENTRAL ARGONNE COMPUTERS

The central computing services provided at Argonne National Laboratory are generally available to all members of the Laboratory, DOE, other U.S. government agencies, and other not-for-profit organizations. Offsite users should contact Argonne's Procurement Department (Building 201, Room 234, extension 2-7030) to obtain an application to use computing equipment. Procurement must approve the application and then make the necessary billing arrangements. Generally, commercial firms are not eligible for Argonne's computing services.

To promote user awareness of relevant policies and practices and to conform to computer protection guidelines, we ask new computer users to acknowledge having read the CTD policy printed on the back of the enrollment form ("CTD Request for Authorization of Computer Account").[7] We prefer that users personally sign the enrollment form before establishing an account; however, to reduce delay in installing accounts, we are prepared to accommodate exceptional situations. One signature per user is sufficient; we do not require additional signatures for users with multiple accounts.

We provide divisions with enrollment forms for new users to complete and send to Account Services. You may obtain additional forms from Account Services (Building 221, Room A-147, extension 2-5425).

We will take enrollment information over the telephone from people whom we recognize, so as not to delay enrollments. However, we expect subsequently to receive a signed form indicating that the user has read and will comply with the policy.

COMPUTER OPERATIONS SCHEDULE

All the central systems and services, except CICS, are available 24 hours a day, seven days a week, except for short interruptions for systems maintenance and hardware maintenance. For a detailed computing center service schedule, refer to a recent issue of the *Argonne Computing Newsletter*.

CHARGES FOR USE OF COMPUTER RESOURCES

CTD charges for the use of computer resources to recover the costs of providing its services. Charges are incurred for all services (including interactive computing, batch computing, graphics, and disk and tape storage). CTD's rates may change from time to time with prior notice.

Offsite users with computer accounts funded by DOE (but not by ANL) incur a surcharge on computing rates to cover Laboratory general administrative expense. Outside users with computer accounts funded by neither DOE nor ANL incur a combination of surcharges for Laboratory general administrative expense, Laboratory general depreciation, depreciation of computing equipment, and DOE administrative expense. For current rates and surcharges, see *Computing and Telecommunications Division Rates*, available at the Document Distribution Counter.

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[7] To read the statement of policy online, enter (in CMS, in Wylbur, or on the VAX cluster):

    HELP ACCOUNT POLICY

CTD charges your computing time to a three-digit cost code assigned to your division and an eight-digit activity code assigned to a particular activity or project within your division. If you are working on more than one project and wish to charge the work for the different projects separately, you can establish a separate account for each project. For users with more than one account, CTD will issue a one-character or two-character "account alias" to your badge number for each account. This "account alias" will distinguish which account CTD will charge when you submit jobs.

Determining Computing Charges

CTD sends monthly invoices (organized by cost center, activity code, and user) to each cost center financial manager showing the costs incurred for all services.

The MVS batch system prints job termination statistics at the end of each batch job. These statistics include the charges for the CPU time, the storage used, I/O transfers (EXCP), and the total charge for the job, based on the default regular batch service rates (Class W). For information on rate classes and computing charges, see *Computing and Telecommunications Division Rates*.

The Wylbur command **DO JOBCOSTS** will report the actual MVS job charges for the previous working day.

The **ja** command in UNICOS shows the resources used by your interactive session or Network Queuing System (NQS) batch job and the total session or batch job cost based on daytime batch service rates.

CMS, Wylbur, and MVS TSO show the resources you have used at your terminal when you logoff. CMS also shows dollar amounts.

The **CHARGES** command in VAX/VMS shows the approximate charges incurred by your current interactive session or batch job. The charges displayed are for the current VAX/VMS process only.

For a standardized summary of all computing costs for a given cost center by activity code and user, enter (in Wylbur):

DO COSTCSUM   (cost center summary) generates a summary report of all monthly charges for a particular cost center by activity code and user.

In CMS and VAX/VMS, you can obtain the same summary by entering the **COSTCSUM** command.

For a standardized summary of all your individual computing costs, enter (in Wylbur):

DO USERDETA   (user detail) generates a summary report of all charges for a specified time period for a particular user.

In CMS and VAX/VMS, you can obtain the same summary by entering the **USERDETA** command.

Users for whom the standard summaries provide inadequate information should consult *Retrieving and Analyzing Computer Usage Accounting Data at ANL* (ANL/TM 402, REVISION 1) to learn how to write SAS programs to extract the data they need.

Obtaining Refunds

A computer user is entitled to a refund of charges for resource usage that occurred as a result of hardware failure, system software failure, error on the part of the CTD staff, or similar circumstances beyond the user's control. The refund will not cover the parts of the job that can reasonably be skipped or suppressed in the rerun. Refunds of less than $50 are not processed. Regardless of the cause of the failure, *no more than 15 minutes worth of CPU time will be refunded for a batch job;* users with programs that require more than 15 minutes for computation should save intermediate results at least every 15 minutes for recovery purposes in case of failure. Users are responsible for backing up their own datasets; refunds will not be given for the cost of recreating lost or damaged datasets. Refunds are also not provided for I/O errors on personal tape reels. To apply for a refund, fill out a "Computer Refund Request" form (available from the Consulting Office) and send it with adequate supporting evidence to the Consulting Office. Your request will be reviewed; and, if a refund is due, it will be applied to your account.

CLOSING OR TRANSFERRING COMPUTER ACCOUNTS

In general, individual users are responsible for the release or transfer of their computing resources (e.g., disk data storage or library tapes) before they terminate their computing accounts. To close a computing account, users should fill out a "Computer Materials

Disposition Form," available from Account Services. This procedure enables users to transfer important files to supervisors or co-workers and to release unnecessary disk and tape files. The form requires a supervisor's approval.

In addition, to ensure that the owners of computing materials arrange for their disposition before the owner's departure from the Laboratory, Human Resources has placed CTD on the clearance list for the termination process. Human Resources will delay a user's termination from the Laboratory until Account Services has received (1) notice from the user to cancel the user's access to computing services and (2) instructions on how to dispose of that user's computing materials.

RESPONSIBILITIES OF COMPUTER USERS

Argonne's computing services are available to assist the work of the Laboratory and the authorized work of other agencies. Laboratory work consists primarily of assigned technical and management work, but also includes professional development undertaken with the knowledge and approval of your supervisor. Laboratory computers should not be used for any other purposes (e.g., games or personal, social, fraternal, or private business).

You are responsible for how your computing account is used. CTD issues a user verification password (called a logon password) with each computing account; your password gives you access to the service in which you are enrolled. The use of passwords is an important part of computer protection at Argonne, because passwords prevent unauthorized use of data and computing resources and ensure the confidentiality of users' files and datasets. DOE requires that computer users be individually accountable for the use of their computer accounts; therefore, *it is CTD's policy that users not divulge their user verification passwords to anyone.* For suggestions for sharing data without sharing user verification passwords, see "Sharing Data Without Sharing User Logon Passwords" below.

Guidelines for User Passwords

When you initially enroll in one of the services on the central computers, Account Services will issue you a password consisting of a sequence of random characters varying in length within the requirement of the operating system. See Table 2 for password requirements and recommendations.

Table 2

Requirements for User Logon Passwords

Policies:

- You can make your passwords any combination of alphanumeric characters, with the first character non-numeric.

- You must change your password at least every six months.

- You should avoid writing your password down anywhere.

- You should avoid storing your password on a personal computer disk or in unprotected disk files.

Recommendations:

- You should make your password at least six characters.

- You should not choose a word easily associated with you.

- Your password should be easy for you to remember.

- Your password should not be a word in the dictionary.

- A good password format is a combination of two short words connected by one or more special characters or numbers.

UNICOS, CMS, and VAX/VMS all have their own password control mechanisms. The IBM services (CMS, MVS batch, Wylbur, MVS TSO, and CICS) are controlled by the IBM Resource Access Control Facility (RACF). One RACF password allows access to all IBM services. For help with RACF passwords, contact your cost center's RACF administrator. (Call Account

Services if you don't know who your RACF adminis-
trator is.) For information about and assistance with
UNICOS and VAX/VMS passwords, contact Account
Services at extension 2-5425.

No one can look up your user verification pass-
word, and Account Services will not divulge passwords
to anyone. If you forget your user verification pass-
word, you can have a new random password assigned
to your account; you must change this password at your
first logon or batch job. If your account is in MVS
batch, Wylbur, CMS, or MVS TSO, contact your cost
center RACF administrator, who will assign the new
expired password. If your account is in UNICOS or
VAX/VMS, contact Account Services to get a new
password; they will first have to establish your identifi-
cation.

You can change your user verification password
as often as you like. RACF and VAX/VMS passwords
expire six months after they were last changed; if yours
expires, you must then change it before you can again
use any MVS or VAX/VMS service. RACF will not
permit you to reuse previous passwords. If you have
confidential or sensitive data, change your password
more often. If you believe someone has learned your
password, change it immediately and contact the Com-
puter Protection Program Manager at extension 2-7440.
Also, if you believe that CTD's security mechanisms
are not working properly or that someone is deliberate-
ly trying to break into one of the systems, inform the
Computer Protection Program Manager.

Do not share your user verification password with
anyone; there are easy-to-use methods for sharing data
without sharing passwords (see below). Also, do not
write your password down where anyone can find it or
store it on a personal computer disk or in an unprotect-
ed disk file where someone can access it.

CTD distributes information on changing pass-
words to new ones in the "Computing and Telecommu-
nications Division Instructions for Passwords and Data
Access" form (available from Account Services).

Password Guidelines for Divisions and Supervisors

When a person leaves a division, the appropriate
supervisor should terminate that person's central
computing account and have all data transferred to
another appropriate account. Change passwords when
individuals involved with a program or set of data
change. Change passwords frequently if
confidentiality is important.

RACF administrators should revoke accounts
when employees are away from the Laboratory for
long periods of time (e.g., faculty members who teach
during the school year and return to the Laboratory
each summer).

Each division's computing system manager
receives a list of all terminating employees each week.
Use this list to ensure that you have closed the accounts
of all terminating employees. If you should be
receiving this list but are not, contact Human
Resources.

Sharing Data Without Sharing User Logon Passwords

A common misconception is that it is difficult or
impossible to share data with other computer users
without giving out user verification passwords.
However, each system on the central computers allows
for sharing of data. In UNICOS and VAX/VMS, you
can assign user categories and access privileges to
individual files and to directories of files to specify
who can use your data and what level of access (read,
write, execute, and delete) they have. CMS users can
issue RACF commands to grant or deny permission for
other users to access data on their minidisks; these
other users who have read or write access privileges
can use the LINK and ACCESS commands to access
files on these minidisks. In Wylbur, use RACF
commands to assign user access to datasets you want to
share. For specific information on using these access
protections, see the documents cited above in
"Guidelines for User Passwords."

Inherited Authorization for Batch Services

Whenever you logon to one of the central computer interactive services (CMS, Wylbur, MVS TSO, CICS, VAX/VMS, or Cray), you can submit a batch job from your interactive session without having to include your user verification password. CTD recommends that you submit batch jobs in this way to eliminate the possibility of someone accessing your password through a network or reading it from a disk file. You can submit UNICOS batch jobs from the MVS front-end station and from the VAX/VMS Cray gateway and the Sun Workstations on the TCP/IP Ethernet without specifying your UNICOS userid or user verification password.

SENSITIVE APPLICATIONS AND DATA

All owners of computer applications must determine (with their Computer Protection Program Representatives) whether any of their applications or the data they process is sensitive. If you have sensitive applications or data, discuss with your Computer Protection Program Representative the steps you are required to take to protect them. You must inform the manager of the computer on which you wish to process sensitive applications before you begin processing them so that you can ensure the needed protection is available. Refer to *Guide to Computer Protection at ANL* (ANL/TM 413) for details; see also the *ANL Computer Protection Policy* in Appendix D of this document. If you see data that is not yours and that you believe is sensitive, contact the Computer Protection Program Manager at extension 2-7440.

If you are going to print sensitive data on printers in Building 221, you must make arrangements with the Computer Operations Manager (Building 221, Room A-113, extension 2-5437). You should identify your output as sensitive to ensure that it is distributed only to authorized personnel. To receive your sensitive output, you must sign a release form.

No classified applications or data are allowed on the central computers. If you need to process classified applications on any other computer, contact the Laboratory's Computer Security Site Manager at extension 2-5739.

ACCESSING CENTRAL COMPUTERS WITH TERMINALS AND WORKSTATIONS

Several choices exist for accessing the central computer systems and other ANL computers:

* ASCII terminals

* graphics terminals

* IBM full screen terminals

* personal computers and workstations with terminal emulation programs

Some choices are better than others, depending on the system or combination of systems you need to use. The following paragraphs describe which terminals and terminal emulation programs are best suited for particular systems (i.e., VAX, IBM, and Cray). In addition, we describe available terminal emulation programs for IBM and Apple Macintosh personal computers and Sun Workstations.

For VAX systems, VT100 or VT200-type terminals or terminal emulators work best. VMS text editors use special function keys available on the keyboards of those terminals. Good terminal emulators will provide all the special function keys available on the VT100 or VT200 keyboard with a minimum of multiple keystroke sequences. For graphics on VAX systems, VT240, VT241, VT330, and VT340 terminals offer both graphics and full screen editing features.

For IBM systems, IBM 3270 terminals or terminal emulators work best. IBM text editors and commands often use program function keys available on the keyboards of those terminals. Good IBM 3270 terminal emulators will provide all the program function keys available on the IBM 3270 keyboard with a minimum of multiple keystroke sequences. For graphics on IBM systems, IBM 3279 terminals provide both graphics and full screen editing features. You can also use ASCII terminals to access IBM systems in line-at-a-time or full screen mode. To enable your ASCII terminal to emulate and take advantage of IBM full screen capabilities, you may use the Hydra Protocol Converter (see "Full Screen Emulation with the Hydra Protocol Converter" below).

For Cray UNICOS and Unix systems, you can use any ASCII terminal or ASCII terminal emulation program.

For IBM personal computers, emulation programs are available that provide VTnnn capabilities, other ASCII terminal capabilities, or IBM 3270 capabilities. Version 3.0 of the Kermit communications program from Columbia University provides Tektronix 4010 graphics and VT320 full screen editing capabilities. Kermit requires the use of a modem or other asynchronous communication interface (e.g., ACI or ADI). The NCSA Telnet program provides Tektronix 4014 graphics and VTnnn screen editing capabilities; additionally, the tn3270 terminal emulation feature provides IBM 3270 capabilities (see "Terminal Emulation with the Argonne Laboratory-Wide Ethernet" below).

For Apple Macintosh personal computers, the Kermit program provides VTnnn capabilities; Kermit requires the use of a modem or other asynchronous communication interface (e.g., ACI or ADI). Kermit diskettes and the *Kermit Users Guide* are available at the Document Distribution Counter. Two programs-- Telnet and tn3270--are available for the Apple Macintosh (see "Terminal Emulation with the Argonne Laboratory-Wide Ethernet" below).

For Sun Workstations, the **telnet** command provides ASCII terminal capabilities, and the tn3270 program provides IBM 3278 full screen editing capabilities. For graphics, the Sun Workstations allow Tektronix 4014 emulation from either the Suntools or the X Window environment.

Terminal Emulation with the Argonne Laboratory-Wide Ethernet

IBM Personal Computer users can use the public domain NCSA Telnet program from NCSA at the University of Illinois for interactive access and file transfer capabilities over the Laboratory-wide TCP/IP Ethernet. The NCSA Telnet program emulates a VT102 terminal and provides several special capabilities, including Tektronix 4014 emulation, an FTP server, and simultaneous sessions on up to 20 host computers (depending on the memory available in your personal computer). Diskettes for the IBM version of NCSA Telnet and *NCSA Telnet for the PC: Version 2.2TN and Version 2.2D* (UD-99 US-14) are available at the Document Distribution Counter.

Apple Macintosh computer users can use two public domain programs: Telnet and tn3270. The NCSA Telnet program provides interactive access and file transfer capabilities by using TCP/IP. NCSA Telnet also emulates a VT102 terminal and provides several special capabilities, including Tektronix 4014 emulation, an FTP server, and simultaneous sessions on up to 20 host computers. The tn3270 program (developed at Brown University by adapting the Telnet program developed by NCSA) provides IBM 3270 terminal emulation for use with Argonne's Conversational Monitor System (CMS), Wylbur system, and CICS. The manuals, *tn3270 for the Macintosh Reference Guide Version 2.0* and *NCSA Telnet for the Macintosh Version 2.3*, and the Telnet and tn3270 diskettes are available at the Document Distribution Counter.

Data transmitted over ANL local area networks is not encrypted. Data privacy relies on each workstation connected to the local area network discarding all but those packets addressed to it. It is not very difficult to retrieve any packet transmitted over the local area network. Users and managers of sensitive applications must include these risks in their standard risk assessment process.

Full Screen Emulation with the Hydra Protocol Converter

When you logon to any of the interactive services on the central IBM computers (CMS, Wylbur, CICS, and MVS TSO), you can use your line-by-line (ASCII) terminal (or personal computer with a terminal emulation program). You can achieve full screen emulation with these IBM services through the Hydra Protocol Converter (extension 2-3270). The Hydra is a dedicated microprocessor connected to the central IBM computers, and it performs the full screen terminal functions that a line-by-line terminal cannot. The Hydra will give you terminal functions compatible with those of an IBM 3270-type terminal. For information on how to use the Hydra and a discussion of IBM full screen terminal capabilities, see *Using the Hydra Protocol Converter for IBM Full Screen Terminal Emulation at ANL* (ANL/TM 457, REVISION 1). CTD recommends and distributes the Kermit terminal emulation and file transfer program for IBM and Apple Macintosh personal computers connected through the Hydra.

THE COMPUTER CALLBACK SERVICE FOR OFFSITE USERS

CTD provides a Computer Callback Service that allows offsite users in Illinois (with area codes 312, 708, or 815) to access onsite computers without incurring large personal costs for telephone charges. To use Callback, dial 1-800-332-1478 and respond to Callback's prompts for your telephone number and the Argonne computer extension you want to call. Callback will then call you back and dial the onsite computer extension for you. When Callback does not work, call 708-972-5421 for assistance.

Users who want to use Callback must make sure that their hardware and software configuration and telephone service are compatible with Callback requirements. Before trying to use Callback, read the *Reference Card for Using the Computer Callback Service* for full instructions.

Users outside the 312, 708, and 815 area codes who want to avoid high long-distance charges may find it less expensive to call a local Tymnet node and connect to one of the central Argonne computers through that network. For more information, see "Tymnet" in Chapter 1 and *How To Use Tymnet Asynchronous Access* (NUD-118USE).

OBTAINING MVS AND UNICOS BATCH JOB OUTPUT

You may direct your printed output from an MVS or UNICOS batch job to any printer or interactive service user on the Laboratory-wide NJE network or on BITnet. To obtain the most current listing of the nodes on the Laboratory-wide NJE network on your terminal screen, enter (in CMS, Wylbur, or VAX/VMS):

        HELP ANLDEST

If you do not specify a destination when you submit a job from a remote station, CMS, or VAX/VMS, the default destination is the place the job originated: a job from a remote station will print at your station's line printer, a job from CMS will return to your virtual reader, and a job from VAX/VMS will return to your [.READER] directory. If you do not specify a destination when you submit a job from Wylbur or MVS TSO, the default destination is the local printers in Building 221. For information on changing default destinations, refer to documentation on MVS or UNICOS and on the method you are using to submit your job.

Certain output (e.g., microfiche or centrally-drawn graphics plots) that cannot be sent to your remote station via the communications link may be sent to your building via a courier service. Inquire at the Computer Output Area (Building 221, Room A-134) for the courier service schedule and ID classifications for distribution locations.

JOB LIMITS

There are limits to how long a job (in CPU time) you can run in each system and how much memory your program can use. To find out these limits, refer to the appropriate documentation for the system you are using. If you need to run a job larger than the maximum allowed, contact the User Services consultants at extension 2-5405; CTD can schedule large batch jobs to run when the necessary computing time is available (usually during overnight or weekend shifts).

You should be cautious with very large or long jobs and use them only when absolutely necessary. Very large jobs may be wasteful, and very long running times expose you to the risks of runaway jobs and increase the chance that a system shutdown or crash will interrupt your job. Regardless of the cause of job failures, our refund policy is restricted to a maximum refund of 15 minutes of CPU time. Therefore, you should checkpoint your long-running jobs so that you can rerun a job from an appropriate intermediate checkpoint instead of having to rerun that entire job.

PRINT LINE LIMITS

Routine batch jobs are restricted to printing a maximum of 50,000 lines. The MVS system will cancel any job specifying a greater line limit on input, unless prior arrangements have been made with CTD. Call the Computer Operations Manager at 2-5437 to make such arrangements. Jobs authorized to print over 50,000 lines will not be printed on paper during prime shifts (Monday through Friday, 7:00 a.m. to 7:00 p.m.). However, large print files destined for the microfiche printer may print at any time.

POLICY ON SOFTWARE MAINTENANCE AND MODIFICATION

Operating systems, compilers, and application programs are generally both large and complex. Customizing these programs with local modifications requires a significant amount of effort and computer resources to prepare, implement, and test the modifications. When software vendors issue new versions of these programs, all local modifications must be reapplied. CTD may have to refit entirely some modifications and may not be able to carry others forward at all. Even if vendors update their software products infrequently, maintaining local modifications can be quite costly. Also, locally modified systems may not function as described in the vendor documentation, and the cost of documenting local modifications is significant. For these reasons, CTD has adopted the policy of minimizing local changes--keeping vendor software as "vanilla" as possible--and relying on vendor documentation. We will use our judgment in making local changes, doing so only when the user benefit clearly exceeds the costs of implementing, documenting, and carrying forward those changes.

All vendors update their software products from time to time. In the interest of providing a stable computing environment, we take precautions before updating our production systems. If a software product is frequently updated by a vendor, we will probably apply several updates at the same time at less frequent intervals (or skip a version) to minimize the frequency of change on our users' environment. If a particular software change is significant, we will announce it in advance and tell you how you can test it before it goes into production.

Feel free to recommend improvements to the systems you use so that we will be aware of their weaknesses. Of course, we cannot implement all user suggestions; but when there is sufficient user interest, as well as a favorable cost/benefit assessment, we will attempt to make reasonable changes. We will also forward user suggestions to the vendors through the various software users groups we belong to (e.g., the IBM SHARE organization, she OBS Wylbur Collect Users Group, and DECUS).

CHARACTER TRANSLATION STANDARDS

CTD has adapted its standard for translating characters between ASCII and the Extended Binary Coded Decimal Interchange Code (EBCDIC) character sets to be consistent with what has become a *de facto* industry standard. Such character translations are important to Argonne computer users because most computing equipment at Argonne uses the ASCII character standard, while all the IBM computers and peripheral equipment in Building 221 use the EBCDIC character standard. Our standardization of the translation between these two character sets (which has been incorporated into all systems, services, and network software) ensures that all jobs and data files transmitted between computing systems or devices will always be translated the same way. The translation tables appear in Appendix C.

CHAPTER 3

SOURCES OF INFORMATION

To use the central computing systems efficiently, you need current information on how to use Argonne systems and software. This information is available through a variety of sources:

- Online HELP

- Printed Documentation

- LOOKUP and DOCUMENT Execs

- *Argonne Computing Newsletter*

- *Computing Center Bulletin*

- Online NEWS Files

- Logon Messages

- Recorded Telephone Messages

- User Services Consulting Office

- User Education Courses and Seminars

- Applications Programming Services

- Administrative Services

OBTAINING DOCUMENTATION ON SYSTEMS AND SOFTWARE

The technical information necessary for using the Argonne computing systems is available (1) through online HELP, (2) in documents obtainable at the Document Distribution Counter, (3) from the LOOKUP and DOCUMENT execs, and (4) from the *Argonne Computing Newsletter*.

Online HELP

The most convenient place to store frequently used reference material is "online," so users can access it when they need it most--while working at their terminals. Online HELP is available in the CMS, Wylbur, and VAX/VMS interactive systems. When a difficulty occurs, searching the information available in the online HELP should be a user's first step in attempting to solve the difficulty; if the difficulty persists, the user should refer to the reference manual and then, if necessary, call the User Services consultants at extension 2-5405.

Documents Available at the Document Distribution Counter

The most comprehensive sources of technical information are the various vendor and locally written computing manuals. A system as diverse as Argonne's requires that a substantial amount of documentation be available locally. To guide you in selecting available manuals that will best meet your needs, see *Recommended Documentation for Computer Users at ANL* (ANL/TM 379, REVISION 2). It contains a "road map" of topics on which documentation is available and lists available documents under those topics.

CTD stocks over 300 documents at the Document Distribution Counter, including an extensive set of Cray manuals (covering the Cray X-MP/14, its operating system, and its available software), IBM manuals (covering hardware and software for the central IBM computers), and DEC manuals (relevant to the central VAX cluster computers and the various divisional VAXes). Vendor software documentation is also available for commercial packages recommended or widely used at ANL. CTD also stocks technical memoranda and ANL reports on computational research written mostly by CTD personnel; the technical memoranda usually provide information specific to the ANL computing environment and other

information not covered by vendor-supplied documentation.

LOOKUP and DOCUMENT Execs

Two execs in CMS, Wylbur, and VAX/VMS can help you find reference material on a topic. The LOOKUP exec will list all citations for a requested topic from the index of the *Argonne Computing Newsletter* and from indexes of locally written user manuals; the DOCUMENT exec lists titles and can provide abstracts (if available) of vendor and locally written documents that CTD stocks.

To use the LOOKUP exec, enter (in CMS and VAX/VMS):

    LOOKUP topic

where "topic" is the subject on which you need information. Enter (in Wylbur):

    DO LOOKUP

The system will then prompt you for a topic. In CMS, every index entry containing the topic as entered will appear on your terminal screen with references to relevant documents and the page numbers. In Wylbur and VAX/VMS, you will receive a file containing the index entries for the topic. For more information on the LOOKUP exec, enter (in CMS, Wylbur, or VAX/VMS):

    HELP LOOKUP

To use the DOCUMENT exec, enter (in CMS or VAX/VMS):

    DOCUMENT topic

where "topic" is the subject on which you need information. Enter (in Wylbur):

    DO DOCUMENT

The system will then prompt you for a topic. You will receive a listing of all documents that contain your requested topic in the title. To receive an abstract of any document, enter (in CMS or VAX/VMS):

    DOCUMENT ABSTRACT document-code

where "document-code" is the unique code that appears in the DOCUMENT listing. For an abstract in Wylbur, enter:

    DO DOCUMENT

and then respond to the topic prompt with ABSTRACT. The system will then prompt you for the document code. For more information on the DOCUMENT exec, enter (in CMS, Wylbur, or VAX/VMS):

    HELP DOCUMENT

Argonne Computing Newsletter

CTD publishes the monthly *Argonne Computing Newsletter*, which is distributed at no charge to approximately 1,700 Argonne computer users. Users of CMS, VAX/VMS, Wylbur, UNICOS, or MVS batch services need this current computing information, so they can be aware of plans and changes that may affect their work.

The *Newsletter* announces all significant changes in system software, hardware, and administrative policies. It also contains the minutes of the Computer Users Group meetings and other computer-related group meetings, and it includes statistical information on computer reliability and use. The *Newsletter* is the official vehicle for communicating computing information, and we encourage all Argonne computer users to read it.

OBTAINING OTHER COMPUTING NEWS

In addition to information available through documents and online reference, CTD regularly announces system changes and service interruptions in advance. These announcements will, depending on the significance of the change or the duration of the interruption, appear as (1) *Computing Center Bulletins,* (2) online NEWS files, (3) logon messages, or (4) recorded telephone messages.

Computing Center Bulletins

News items of a more urgent nature are announced in special *Computing Center Bulletins* sent to all Argonne personnel on the *Argonne Computing Newsletter* mailing list.

Online NEWS Files

CTD maintains an online NEWS file that is updated with news items as they develop. To scan this NEWS file, enter (in CMS and VAX/VMS):

NEWS

To scan this NEWS file, enter (in Wylbur):

DO NEWS

Logon Messages

Short messages related to system availability will appear on your screen when you logon to CMS, VAX/VMS, Wylbur, or MVS TSO. UNICOS users will have similar messages printed at the beginning of their output. MVS batch users will get such messages at the end of their batch job output. The operators can also send short messages and warnings that will appear immediately on the terminals of all logged-on users.

Recorded Telephone Messages

Users of the computing center computers may call extension 2-5466 for a 24-hour recorded message describing the current system status of the computers in Building 221.

Users of the AMPS, STS, and MCRS administrative applications may call extension 2-8952 for a 24-hour recorded message describing the current system status of the Hewlett-Packard computers in Building 201.

CONSULTING

User Services consultants are available to assist computer users who have already made reasonable but unsuccessful efforts to solve their difficulties. Table 3 shows where and when you can see the consultants. The consulting service, in general, is free (i.e., it is included in the rates for central services). However, consultants will ask you for userid information for internal reporting purposes.

If you have an involved question or are unfamiliar with the computer system you are using, come to the office in person. For simple questions, you may call the office. When the consultants are busy, you may get a recorded message to leave your number; do so, and they will return your call as soon as possible.

Table 3
User Services Consulting Office

Location	Building 221, Room A-139
Telephone	(708) 972-5405
Office Hours	Monday through Friday 8:30 to 11:30 a.m. and 1:00 to 5:00 p.m.
Electronic Mail Address	
BITnet:	CONSULT AT ANLVM
DECnet:	ANLVM::CONSULT
Internet:	consult@anlvm.ctd.anl.gov

You may also contact the consultants via electronic mail. CMS and VAX/VMS users should send mail to user CONSULT. For information on how to send mail, see *Electronic Mail at ANL* (ANL/TM 431, REVISION 2). Wylbur users may send mail automatically by entering DO CONSULT. The system will then prompt you for further information and will place your message in a queue that the consultants will attend to as soon as they have an opportunity.

Unless you indicate otherwise, the consultants will send a response to your CMS virtual reader, your VAX/VMS mailbox, or your Wylbur fetch queue, depending on where your request originated.

Scope of Consulting Services

The consultants are prepared to provide assistance for the central computers (including operating system commands, Fortran compilers, editors, and graphics). Consultants may be familiar with the capabilities of other systems and do provide assistance on a best-effort basis; however, for inquiries not related to central services, we may need to refer you to a more appropriate source for assistance.

The consultants help in diagnosing and solving programming errors and system bugs. Their office is also the collection point for reports of software and hardware malfunctions, suggestions for system design changes, refund requests, requests for restoring damaged data files, and a variety of miscellaneous requests. They can help you in your selection of services (e.g., interactive versus batch or IBM versus VAX) and applications (e.g., Disspla versus Tellagraf). They also provide advice on designing and modifying code to achieve better job performance and more efficient use of system resources.

The User Services consultants will attempt to give you on-the-spot answers for most questions or to direct you to appropriate sources of information. They may defer complicated questions (e.g., on difficulties in the use of mathematical software libraries) for more investigation or refer them to another person more knowledgeable in the area. For suggestions and issues that need to be followed through, they will fill out a "Problem Report" (also known as a "Bug Form") and route it through the appropriate channels.

Debugging large and complex programs can be tedious and time consuming. In some cases, consultants may not discover an immediate solution and may only be able to suggest a strategy for debugging your program. If you desire to have a consultant dedicate effort for an extended period to implement or debug your program, you may need to provide an account code or service request.

User Responsibilities

User Services expects you to make a reasonable effort to resolve your difficulty before you contact a consultant; you should be familiar with the online HELP and have looked at available documentation. When you come to the Consulting Office, bring complete and accurate information about the conditions under which the difficulty occurred. Describe your difficulty to the consultant on duty in Room A-139;

please do not approach off-duty consultants in their offices.

Although User Services makes every effort to answer your queries as promptly and thoroughly as possible, at times the level of service may not meet your expectations. Please remember that the office operates within the constraints of limited staffing and a limited budget and that User Services must assign priorities based on the importance of the work and the number of users affected.

USER EDUCATION

It is important to have a well-informed user community. CTD offers several instructional sessions taught mostly by User Services staff. Interactive computer-based training courses are also available online.

User Services Instructional Sessions

User Services regularly offers short computing courses on a variety of subjects relevant to Argonne computer users. These courses are not only for new and temporary staff but also for experienced staff members. Our current offerings include courses on how to use Argonne central computing systems (e.g., CMS, VAX/VMS, Wylbur, MVS batch, and UNICOS) and application packages (e.g., Tellagraf, SAS, and Script) efficiently. Occasionally, we also hold special workshops and demonstrations (e.g., "Using the Hydra Protocol Converter for IBM Full Screen Emulation" and "Using SAS on an IBM Personal Computer"). Announcements of such offerings appear on Laboratory bulletin boards and in the *Argonne Computing Newsletter*. We normally offer the courses several times a year. To register for any of these offerings, call User Services at extension 2-5405. Most are free of charge.

Computer-Based Training (CBT) Courses

Computer-Based Training (CBT) courses are available online to give computer users instruction on computing services and some commonly used software products available at Argonne. Some of the courses currently available are in CMS; there are also several courses on DEC computing products available in VAX/VMS. No enrollment is necessary. For a listing of courses currently available, see the current issue of the *Argonne Computing Newsletter*.

To take the VAX/VMS CBT courses, you should have a DEC VT100 (or compatible) terminal. For specific information about any CBT course in VAX/VMS, enter:

HELP course

where "course" is the name of the course you want information about. To invoke a course, enter:

RUN course

PROGRAMMING SERVICES

Special programming services may be available for a given project:

Special Applications

Users who need extended consulting services for a project or need a programmer to design a program for them should contact the User Services Manager at extension 2-7419. If User Services can provide the service you need, you will have to fill out a "Service Request" form. There is an hourly charge for this service; see *Computing and Telecommunications Division Rates*.

Administrative Applications

Management Information Systems (MIS) analyzes, designs, and programs administrative or management applications. Users who need assistance in determining the suitability of an application or in developing the application should contact the MIS Manager at extension 2-7156.

Real-Time Systems

Software and hardware expertise is available from Electronics for the design and development of real-time data acquisition and control systems and data graphics displays using many of the current computer systems (e.g., IBM Personal Computer, Apple Macintosh, VAX, Sun, and Motorola). Electronics can design custom-built interfaces to connect the experiment to any of these computer systems that provide an external bus connection. For further information about real-time applications, call extension 2-6961 or 2-6983.

Minicomputer Systems

Electronics provides consulting and programming help for DEC, VAX, and PDP-11 computers running the VMS, Unix, RSX-11m/M+, and RT-1 operating systems. Electronics has a VAXcluster used for development work and programming support of real-time data acquisition and control systems.

ADMINISTRATIVE SYSTEMS

Integrated Financial System

IFS is the most widely used administrative system. IFS provides user reporting by using the Information Expert (IE) report writer. IFS-IE runs in CICS and submits MVS batch jobs to create standard reports that provide a wide array of budget and cost information. This system is accessible to Laboratory management and other persons who are authorized to use administrative data.

Human Resource System

The Laboratory-wide Human Resource System (HRS), a reporting database system, runs in CMS and creates standard reports that provide a wide array of personnel information for division and program management. The Inquire database management system (from Infodata Systems) is used to maintain and interrogate this database. This system is accessible to Laboratory management and other persons who are authorized to use administrative data. Authorization requires enrollment through Account Services. Applicants can pick up enrollment forms in person at the Account Services office (Building 221, Room A-147) or can call extension 2-5425.

Argonne Materials Order System

Several catalogs of materials that you can order with the Argonne Materials Order System (AMOS) are available on the Laboratory's IBM mainframe computers. To search or print the computerized materials catalogs, use MCAT in CICS or the STORECAT exec in CMS.

To place an AMOS order, use one of the following methods:

1. Call the AMOS Order Entry clerk at extension 2-7523.

2. Mail a "Request for Stores Material" form (ANL-32A) to AMOS Order Entry, SSD-MS, Building 4.

3. Use the STORES ORDER exec in CMS or on the VAX 8700 and follow the prompts.

With each of the above methods, furnish ordering information (e.g., cost code, item number, and quantity). Since some divisions have authorized only certain individuals to place AMOS orders, you may have to place your order through someone in your division office.

Library Information Management System

The BASIS Techlib software package (from Information Dimension) will provide online information to ANL staff and will manage the records of the Technical Publications Services (TPS). The first component of the system is scheduled to be operational during the summer of 1990 and will operate on CTD's VAX 8700 computer. This system will be accessible to the Technical Information Services (TIS) staff and all ANL staff through terminals located in the libraries. ANL staff will also be able to access the system by using their office workstations via the existing telecommunication networks at the Laboratory.

Hewlett-Packard Applications Assistance

Users of the AMPS, STS, and MCRS administrative applications may call extension 2-8952 for a 24-hour recorded message describing the current system status of the Hewlett-Packard computers in Building 201.

COMPUTER SECURITY

Anti-Virus Teams

Because of the Laboratory's experiences with the virus that hit several national computer networks in early November 1988, CTD has established teams for each major operating system at the Laboratory to prevent a successful attack or to mitigate the effects of

such an attack. Team membership includes system experts both within and outside CTD. Table 4 lists the team leaders and their telephone numbers.

Report all computer viruses, attempted system break-ins, or other incidents that represent a threat to ANL computer systems to Jean Troyer (Computer Protection Program Manager) at extension 2-7440.

Table 4
Anti-Virus Team Leaders

Apple Macintosh Family	Paul Steimle (EID)	2-4148
IBM Personal Computer Family	Roxanne Izzo (CTD)	2-7205
MVS Systems	Doug Engert (CTD)	2-5444
Unix Systems	Rick Stevens (MCS)	2-3378
VM Systems	Joe Midlock (CTD)	2-5447
VMS Systems	Rich Raffenetti (CTD)	2-8497
Cray Computer	Joe Midlock (CTD)	2-5447

Remote Mainframe Logins

The capability for using remote logins (e.g., VAX/VMS proxy login, Unix .rhost, and NFS) to access computers from accounts on other computers has made the lives of computer users easier. Computer users no longer need to remember separate passwords for all the computers on which they have accounts. These methods enhance computer security by reducing the number of passwords transmitted in clear text through the networks but, at the same time, introduce other security risks (e.g., "spoofing"). ("Spoofing" is the assumption of the identity of one computer by another, usually via the use of the Internet IP address.)

Any data accessible by remote login is only as secure as data on the least secure computer in the chain. Remote logins will propagate any poor security practices from local computers to the mainframe. To ensure individual accountability on local systems, your system manager must take care in setting system parameters and in establishing secure practices to prevent access to your local system by unauthorized

persons. You must also use good password practices to ensure individual accountability on your local computer. Any time accountability on local systems is compromised and the local system users avail themselves of remote logins to mainframe computers, the mainframe accounts will also be compromised. Remember, all ANL and DOE computer security policies require users with computing accounts to maintain individual accountability; failure to do so (e.g., by sharing login passwords with others) is a computer security incident reportable to Laboratory management.

When you elect to use the convenience of remote logins, be sure you and your local system manager adhere to good computer security practices.

See Appendix D, "ANL Computer Protection Policy."

CHAPTER 4

APPLICATION SOFTWARE, MATHEMATICAL LIBRARIES, AND UTILITIES

This chapter describes software available on the computers in the central complex. (Other software is available through the National Energy Software Center [NESC], which maintains a computer program exchange and information center for the entire Department of Energy. For further information, see "Programs Available through the National Energy Software Center" at the end of this chapter.)

All of this software is available to Argonne computer users without restriction. However, use of certain software by outside users (non-Argonne or non-DOE) is prohibited by the software vendors. Usually, each outside user or organization must obtain permission from the vendor of the software package (and frequent-ly must pay an additional surcharge). Software packages in this category include:

Data Connection	SAS
Disspla	Script
Historian	Speakeasy
IMSL	Tellagraf
Librarian	

APPLICATION SOFTWARE

Table 5 provides an overview of the available application software.

<table>
<tr><td colspan="3" align="center">Table 5

Overview of Available Application Software</td></tr>
<tr><td>Application</td><td>Product</td><td>Where Available</td></tr>
<tr><td>Statistical Analysis</td><td>SAS
BMDP
Speakeasy</td><td>CMS, MVS batch, VAX/VMS
MVS batch
CMS</td></tr>
<tr><td>Symbolic Algebra</td><td>REDUCE
DOE-MACSYMA</td><td>CMS
VAX/VMS</td></tr>
<tr><td>Terminal Enhancement</td><td>IBM VM/370 DMS
DEC FMS
DEC TDMS</td><td>CMS
VAX/VMS
VAX/VMS</td></tr>
<tr><td>File Transfer and
   Terminal Emulation</td><td>Kermit
FTP</td><td>CMS, VAX/VMS
CMS, UNICOS, VAX/VMS</td></tr>
</table>

Table 5 (Continued)		
Overview of Available Application Software		
Application	**Product**	**Where Available**
Text Processing	Waterloo Script Mass-11 TeX LaTeX	CMS, MVS batch VAX/VMS VAX/VMS VAX/VMS
Database and File Management	Datatrieve DECalc-Plus DEC CDD	VAX/VMS VAX/VMS VAX/VMS
Sorting and Merging	DFSORT SORT SORTF	MVS batch CMS CMS
Source Code Maintenance	Librarian Historian DEC CMS DEC MMS update sccs make	MVS batch MVS batch VAX/VMS VAX/VMS UNICOS UNICOS UNICOS
Office Automation	PROFS	CMS
Engineering Applications	ANSYS CSMP III THTB	VAX/VMS CMS, MVS batch MVS batch
Mathematical Libraries	IMSL NAG DOE SLATEC AMDLIB CERNLIB	CMS, MVS batch, UNICOS, VAX/VMS CMS, MVS batch, UNICOS, VAX/VMS UNICOS, VAX/VMS CMS, MVS batch VAX/VMS

Statistical Analysis

Two major packages are available for statistical analysis of data: the Statistical Analysis System (SAS), from the SAS Institute, and the Biomedical Computer Programs (BMDP), from the University of California. Also, the Speakeasy language offers some statistical functions. In addition, we maintain libraries of statistical routines (see "Mathematical Libraries" later in this chapter). In general, SAS has the widest range of functions, and Speakeasy is the easiest to learn

and use. BMDP also has a wide range of functions, some of which are unavailable in SAS.

Statistical Analysis System

The Statistical Analysis System (SAS) is a popular statistical analysis package that is equally applicable to data in physical sciences, social sciences, business, medicine, marketing, and other fields. We recommend it to scientists and administrators alike. SAS is avail-

able in CMS, MVS batch, and VAX/VMS. It provides all the tools needed for data analysis: information storage and retrieval, data modification and programming, statistical analysis, and file handling. It can produce reports tailored to your requirements. SAS provides access to a library of statistical subroutines for analysis of variance, analysis of correlation coefficients, discriminant analysis, factor analysis, creation of frequency and cross-tabulation tables, least-squares fitting, matrix manipulation, nonlinear regression, ranking, sorting, evaluation of t-tests, and other statistical procedures.

Although SAS is primarily a powerful statistical tool, you can also use it as an information retrieval system or a report-generating program because of its extensive database management capabilities. With SAS/Graph (an option of SAS), you can also produce plots and charts in black and white or color on graphics terminals, plotters, and other hardcopy devices.

To learn how to use SAS, read the *SAS Introductory Guide* (0-917382-73-0). To learn how to use SAS/Graph, read the *SAS/Graph User's Guide Version 5 Edition* (0-917382-68-4). For some usage information, enter (in CMS and VAX/VMS):

HELP SAS

Also, see the *SAS Companion for the CMS Operating System* (1-55544-001-0) and the *SAS Companion for the VMS Operating System, 1986 Edition* (0-917382-98-6). Several Computer-Based Training (CBT) courses for SAS are available in CMS.

Biomedical Computer Programs

The Biomedical Computer Programs (BMDP) package is another tool for statistical analysis at Argonne. BMDP was designed primarily for biomedical applications but now is also used for statistical analysis of data in other fields. BMDP is available only in MVS batch. It provides a wide range of analytic capabilities that range from plots and simple data description to advanced statistical techniques. It has a library of subroutines for data description, generation of frequency tables, multivariate analysis, regression, analysis of variance, and other special programs. This library is interrogated by a common quasi-English control language and by self-documenting BMDP save files for data and results. For further information, see the *BMDP Statistical Software Manual* (0-520-06473-9).

Speakeasy

Users familiar with Speakeasy may find it convenient to use the statistical capabilities it offers. To obtain further information about these capabilities, after invoking Speakeasy, enter (in CMS):

HELP STATISTICS

Tutorial information on Speakeasy statistics is available interactively (enter **TUTORIAL STAT** when in Speakeasy), in the *Speakeasy IV Reference Manual*, and in *Lectures on Speakeasy* (especially Chapter 5).

Symbolic Algebra Programs

Two symbolic algebra programs--REDUCE and DOE-MACSYMA--are available in CMS and VAX/VMS respectively.

REDUCE

The symbolic algebra program REDUCE is available in CMS. Its capabilities include factorization and expansion of multivariate polynomials, decomposition of rational functions into partial fractions, reordering of formal power series, analytic differentiation and integration, calculation of symbolic matrices, arbitrary-precision arithmetic, and substitutions and pattern matching in a wide variety of forms. Also included in REDUCE is an ON FORT option that generates Fortran-compatible statements that you can insert into your Fortran programs.

For further information on how to use REDUCE, read the *REDUCE User's Manual*.

DOE-MACSYMA

DOE-MACSYMA is a symbolic algebra program that contains programming capabilities with a language called NIL (a dialect of LISP). DOE-MACSYMA was developed at the Massachusetts Institute of Technology and is released by DOE. With DOE-MACSYMA, users can differentiate, integrate, take limits, solve systems of linear or polynomial equations, factor polynomials, expand functions in Laurent or Taylor series, solve differential equations (using direct or transform methods), compute Poisson series, and manipulate matrices and tensors. MACSYMA has a language similar to ALGOL-60 to permit users to write their own programs for transforming symbolic expressions.

DOE-MACSYMA is available in VAX/VMS. For more information, see the *MACSYMA Reference Manual* or enter (in VAX/VMS):

```
MATHDOC
```

Terminal Enhancement Packages

Generally, there are two types of terminals in use at ANL, IBM 3270-type (full screen) terminals and ASCII (line-oriented) terminals. The IBM interactive services make special use of the 3270 full screen features.

There is hardware (the Hydra Protocol Converter) that will allow ASCII terminals and personal computers with ASCII terminal emulation programs to emulate IBM full screen terminals. Users of ASCII terminals should be aware that the most efficient way to emulate full screen terminals is to use the Hydra Protocol Converter (see "Full Screen Emulation with the Hydra Protocol Converter" in Chapter 2).

The Display Management System (DMS) package (described below) assists in designing and building full screen formats (menus).

Two packages available in VAX/VMS--the Forms Management System (FMS) and the Terminal Data Management System (TDMS)--allow you to design screen formats on DEC VT100-compatible terminals.

IBM 3270 Display Management System

The IBM VM/370 DMS for CMS is available for use on IBM 3270-compatible display terminals or ASCII terminals and personal computers emulating IBM 3270 terminals. DMS consists of an Interactive Panel Formatting function and a Panel Management function that allow the user of an IBM 3270-compatible display terminal to design and build screen formats (menus) and to use the full screen capabilities of display terminals to transfer data between the menus and application programs written in CMS EXEC2, PL/I, Cobol, and IBM Assembly Language.

To access DMS, enter (in CMS):

```
CP LINK DMS 1 vaddr
ACCESS vaddr filemode
```

where "vaddr" and "filemode" are any unassigned virtual address and filemode letter in your virtual machine.

IBM VM/SP: Display Management System for CMS: Guide and Reference (SC24-5198) contains the information necessary to build and use DMS screens.

DEC Forms Management System

DEC FMS allows the creation and use of forms for data entry and retrieval with a VT100-compatible terminal. Using FMS, a programmer can create screens independent from the application program with special video characteristics (e.g., reverse video or bolding). FMS is available in VAX/VMS.

DEC Terminal Data Management System

DEC TDMS is a programmer tool designed for the implementation of interactive, forms-intensive applications. It provides a fourth-generation language record-level interface to define screen or program data exchange, which results in terminal or data independence. TDMS provides transparent application program data mapping and conversion with VAX database programs. It is available in VAX/VMS.

File Transfer and Terminal Emulation

Kermit

The Kermit file transfer program distributed by Columbia University is available at Argonne to enable selected personal computers to emulate an ASCII terminal and to send files with error checking to and from CMS or VAX/VMS. The Kermit program in CMS and VAX/VMS communicates with a corresponding Kermit program on a personal computer to transfer files. CTD has installed the Kermit terminal emulation and file transfer program to meet the general need for reliable file transfer between the central IBM computers, the VAX 8700, and personal desktop computers.

CTD distributes Kermit diskettes for the most popular personal computers at a nominal cost; they are available at the Document Distribution Counter. Kermit is available to users of the IBM Personal Computer or a compatible (with Release 2.0 or later of the PC-DOS/MS-DOS operating system) and to users of the Apple II and the Apple Macintosh. For information

on using Kermit with the IBM Personal Computer, enter (in CMS):

    HELP KERMIT IBM

For information on using Kermit with the Apple II, enter (in CMS):

    HELP KERMIT APPLE

For information on using Kermit with the Apple Macintosh, enter (in CMS):

    HELP KERMIT MACINTOSH

CTD does not plan to distribute diskettes for any CP/M personal computer.

Kermit allows Apple Macintoshes to emulate DEC VT-102 terminals and IBM Personal Computers to emulate DEC VT-102, DEC VT-52, and Heath H-19 terminals. CTD provides key mapping files for IBM Kermit and Apple Macintosh Kermit that permit excellent IBM 3270 terminal emulation with the Hydra Protocol Converter. These key files are on the CTD Kermit distribution diskettes and can also be downloaded from CMS. For more information, enter (in CMS):

    HELP HYDRA KERMIT

Or see "Full Screen Emulation with the Hydra Protocol Converter" in Chapter 2.

Users of CMS, the DEC VAX computers on the Laboratory-wide NJE network, and the central VAX 8700 can obtain information about any available Kermit program for personal computers by using the KERMSRV service on the BITnet network. For instructions on using KERMSRV, enter (in CMS):

    HELP KERMIT KERMSRV

Or enter (in VAX/VMS):

    HELP KERMIT

CTD has not tested all the Kermit programs available on KERMSRV. Users may wish to invest their own effort to install Kermit programs obtained via BITnet. For the list of personal computers that can communicate with Kermit, see the *Kermit User Guide.*

File Transfer Protocol

The Internet File Transfer Protocol (FTP) is available at Argonne to allow users to log into a remote system, to identify themselves, to list remote directories, to copy files to or from the remote machine, and to execute a few simple commands remotely. FTP can transfer text and binary files across systems and provides for conversion between ASCII and EBCDIC character sets. FTP is available on most machines at Argonne that are connected to the Laboratory-wide Ethernet, because it relies on the TCP/IP protocol. FTP is also available for the IBM Personal Computer and the Apple Macintosh connected to the Laboratory-wide Ethernet via software called *NCSA Telnet,* available at the Document Distribution Counter.

FTP offers a helpful command mode that assists in transferring files to and from remote hosts. To invoke FTP, enter:

    ftp

Then press the RETURN button. The FTP prompt will appear.

To learn about all the commands available within ftp, enter:

    help

Depending on the system, help may also be available by entering **help ftp** or **man ftp.**

Text Processing

Waterloo Script (with GML) in CMS and MVS batch and Mass-11 in VAX/VMS are available text formatting packages.

Waterloo Script

The Script program from the University of Waterloo is available for text formatting applications (e.g., preparing office correspondence, papers, manuals, reports, proposals, and other publications). Script (which is available in both CMS and MVS batch) is widely used throughout the Laboratory by both the scientific and administrative staffs. The Formula Processor that is part of Script makes it possible to enter mathematical and scientific notations as part of a document. A companion document layout package, Waterloo Generalized Markup Language (GML), provides

several easily selectable document layouts for use with Script.

The power of Script is most helpful in the preparation of large, structured documents containing footnotes, tables, figures, indices, and tables of contents. With Script and GML, it is possible to automate the preparation and maintenance of documents and to standardize their layouts. Script simplifies the process of revising and updating documents, eliminating the need for manually retyping many pages to incorporate small changes.

The typical Script input file consists of a specified GML layout, the text to be formatted, and the appropriate Script control words. The output produced by Script is a formatted file consisting of the formatted text on fully composed pages according to the specifications of the Script control words. In the central computing complex, you can print Script output on the IBM 1403 TN train printer, the IBM 3800 laser printer, and on Apple LaserWriters. The Apple LaserWriter will produce high quality output and is capable of printing text and graphics on the same page. Additional Apple LaserWriters are available in other Argonne organizations, and a publication quality printer (the 2480-dot-per-inch Linotype L300P typesetter) is available in Graphic Arts. (*Guide to Computing at ANL* was produced with GML and Script and printed on the L300P typesetter.)

For further information, see the *Waterloo Script User's Guide*, the *Waterloo Script Reference Manual*, the *Waterloo Script GML User's Guide*, *Waterloo Script with Formula Processing*, and *Waterloo Script and a PostScript Printer*.

Mass-11 Word Processing

Mass-11 (from Microsystems Engineering Corporation) is a word processing program available in VAX/VMS. It is efficient in preparing a wide variety of documents (e.g., papers, manuals, and letters). It is especially useful for technical writing, because it contains many mathematical symbols. Mass-11 uses menus and easily remembered commands to allow for formatting scientific equations, multi-column text, and statistical tables.

To invoke Mass-11, at the DCL prompt ($) enter (in VAX/VMS):

    MASS11

For information about Mass-11, see the *Mass-11 Word Processing VAX/VMS Reference Manual (Version 7-A)*.

TeX and LaTeX

TeX is a sophisticated program available in VAX/VMS designed to produce high-quality typesetting, especially for mathematical text. For more information about TeX, see *The TeXbook* (0-201-13448-9).

LaTeX adds to TeX a collection of commands that simplify typesetting by letting you concentrate on the structure of the text rather than on formatting commands. For more information about LaTeX, see the *LaTeX User's Guide and Reference Manual* (0-201-15790-X).

Both LaTeX and TeX require a great deal of time to master; however, LaTeX is easier to learn than TeX.

Standalone Word Processors and Workstations

Many organizations in the Laboratory use dedicated word processors or personal computers with word processing.

Many word processing programs are available for personal computers. CTD uses Microsoft Word with both the IBM Personal Computer and the Apple Macintosh. Microsoft Word is available in disk formats for both, and files created in Microsoft Word on either personal computer can be transferred easily to the other through a LAN. See Chapter 1 for discussions of LANs.

Database and File Management

The database management systems available for general use on the central complex computers at Argonne are SAS and Datatrieve. See also Chapter 1 for a description of the CICS interactive service, which provides access to administrative database applications.

Statistical Analysis System

In addition to its wide statistical application, the Statistical Analysis System (SAS) provides substantial data analysis capabilities. See a discussion of SAS under "Statistical Analysis System" above.

Datatrieve

Datatrieve is a comprehensive fourth-generation data management tool (available in VAX/VMS) for defining, storing, updating, and displaying data. It is often used with the VAX Common Data Dictionary (CDD) for interactive and program-callable access to data in sequential, indexed, or relative file organizations. Some features include query writing facilities, report writing facilities, and graphics capability.

To invoke Datatrieve, enter (in VAX/VMS):

```
$ RUN SYS$SYSTEM:DTR32.EXE
```

For more information, invoke Datatrieve and enter (in VAX/VMS):

```
HELP
```

Also, to access the online Datatrieve computer-aided instruction (CAI) training course, enter (at the DCL prompt):

```
$ RUN DTRCAI
```

DECalc-Plus

DECalc-Plus is a multi-user spreadsheet system designed especially for engineering, scientific, and technical applications. It includes functions that do matrix mathematics, numerical analysis, and regression analysis. DECalc-Plus is available in VAX/VMS.

DEC Common Data Dictionary

The DEC Common Data Dictionary (CDD) is the central repository for data definitions. In addition to user applications, such VAX Information Architecture products as Datatrieve and TDMS use CDD. CDD is frequently used to isolate data definitions from the program development process.

Sorting and Merging

Programs are available to sort or merge records in files according to a given sequence.

For large sorts requiring many resources, use the IBM DFSORT program in MVS batch. DFSORT can sort and merge records in ascending or descending order. User exits can be provided for special processing of individual records. To invoke the DFSORT program in batch, use the SORT cataloged procedure (if you are including user routines); use the SORTD procedure if you are not including user routines and do not require linkage editing.

In CMS, use the SORT command to invoke the IBM CMS sort program (which is limited to arranging records in ascending order according to specified fields). To learn more about CMS SORT, enter (in CMS):

```
HELP SORT
```

An enhanced sort program--SORTF--is also available in CMS. In addition to the basic character sort, it also sorts fixed-point, floating-point, zoned, and packed decimal fields. Sorting may be done in ascending or descending order, or in a special sequence in which uppercase and lowercase letters are considered the same and embedded blanks and special characters are ignored. To learn more about SORTF, link to the "SORTF 2" disk and enter (in CMS):

```
SCRIPT SORTF
```

Do not sort large (several thousand records) files in CMS.

Source Code Maintenance

Users with many files that contain source code, JCL, data, or any other information will need some tools for updating and organizing files. CMS, VAX/VMS, and Wylbur offer utilities for editing and maintaining source files. In addition, there are several commercial software packages for source code maintenance.

Wylbur and CMS Commands

For source code maintenance, CMS users can use the UPDATE command described in *IBM VM/SP:*

CMS Command and Macro Reference Release 5 (SC19-6209). The CMS editor also provides commands for maintaining source files. MVS batch users may use the editing and file-maintenance capabilities offered by Wylbur.

Librarian

The Librarian program is a generalized data storage and retrieval system designed specifically to assist programmers in developing and maintaining source programs. Source code for many subroutines may be placed into one Librarian "master file." Because Librarian files are stored in a compressed format, they reduce both machine time and disk space requirements. Simple, efficient back-up procedures are provided for backing up Librarian files on tape. The Librarian program also provides simple commands for creating a new module (as each member of the master file is called); for deleting a module; for selecting a module to be updated, listed, compiled, or processed in any other way; and for inserting, deleting, editing, or replacing records within a module. You can perform (with little effort) global scans and updates of all modules or subsets of all modules. Extensive documentation resources (both automatic and user-invoked) provide detailed records of all changes made to a module. Librarian reports provide complete up-to-date records of the status of each module, indicating which modules have been altered and identifying the records that were modified.

The Librarian program is available in MVS batch only. Wylbur can read (but not write) Librarian files. Several batch cataloged procedures are available to aid you in using Librarian.

Historian

The Historian source code maintenance program allows you to store and update source libraries, to track and analyze all changes to a library, to reverse changes to obtain previous versions of a library, and to transport libraries between dissimilar computing systems. The Historian program is upward compatible with the UPDATE utility program on CDC and Cray computer systems. Historian is available only in MVS batch.

The DEC Code Management System

The DEC Code Management System (CMS) is a library system that makes developing and maintaining software easier by saving successive versions of programs. Some other features of DEC/CMS include recording the changes that are made to programs, informing programmers of concurrent module access, and merging concurrent edits. DEC/CMS is available in VAX/VMS only.

The DEC Module Management System

DEC Module Management System (MMS) is a software system that uses commands and dependency rules stored in a user-created file to compile and link modules. DEC/MMS can become an integrated software development system when used with DEC/CMS. DEC/MMS can rebuild components of a system based on changes since the last update of the system. DEC/MMS is available in VAX/VMS only.

The UNICOS UPDATE Utility

The UNICOS UPDATE source code maintenance program allows you to store and update source libraries, to track and analyze all changes to a library, and to reverse changes to obtain previous versions of a library. You can use UPDATE in UNICOS and Historian in MVS to maintain compatible libraries on the two systems. For related information, see UPDATE in the *UNICOS User Commands Reference Manual* (SR-2011 5.0).

UNICOS Source Code Control System

The UNICOS Source Code Control System (SCCS) is a source code maintenance program that stores files as layers of documented changes that are successively applied to an empty version of the file. With SCCS, you can retrieve any version of a program you want and trace any changes to a program. The SCCS **DELTA** command will automatically generate a change set for a newly edited version of a program. For more information about SCCS, enter (in UNICOS or other Unix systems):

man sccs

The UNICOS MAKE Utility

The UNICOS MAKE utility is often used with SCCS to develop and modify applications. MAKE searches a designated application for modified files that need to be recompiled. For more information about MAKE, enter (in UNICOS or other Unix systems):

```
man make
```

Or see *A Practical Guide to Unix System V* (0-8053-8915-6).

Office Automation with PROFS

PROFS (Professional Office System) is an IBM *office automation program* available in CMS. It gives users flexibility in sending and routing electronic mail and in making meeting schedules. With PROFS, you can select functions from on-screen menus with program function (PF) keys on your IBM full screen terminals or corresponding keystrokes through a full screen terminal emulator (e.g., the Hydra Protocol Converter; see Chapter 2). PROFS provides electronic mail capabilities, scheduling calendars, and a proofreading package; it also has a document preparation function, though CTD recommends using the Xedit editor and Waterloo Script and GML for text processing in CMS.

There is a separate enrollment for PROFS. To establish a PROFS account, contact Account Services at extension 2-5425.

Engineering Applications

Many engineering applications are available on the central computers. Following are a few of these applications:

ANSYS

The ANSYS Structural Analysis Program (from Swanson Analysis System, Inc.) is available on the central VAX 8700 computer. The ANSYS software package costs $2.04 per CPU minute. With ANSYS, you can interactively prepare input data and process ANSYS graphical output. For more information, see the *ANSYS Execution Guide (ANSYS User's Manual-- Appendix S) Revision 4.3.A VAX/VMS Version.*

Continuous Simulation Modeling Program III

The Continuous Simulation Modeling Program III (CSMP III) is an IBM program product designed for the digital simulation of continuous processes. The input language enables you to prepare statements describing a physical system, starting from either a block diagram or a differential-equation representation of that system. CSMP also accepts Fortran statements, thereby allowing you to handle complex nonlinear and time-variant problems. You can get the solution as either a table or a graph. CSMP III has been successfully used for the solution of nonlinear differential equations, feedback control systems, machine design, simulation of systems described by state-variable equations, digital logic circuits, machine-tool systems, space-vehicle dynamics, process control systems, systems involving digital computers performing real-time calculations, simulation of power systems, and other applications. Although CSMP is an outstanding tool for many problems, it is not best for very large-scale simulation problems (e.g., the detailed simulation of a steam-generating plant). These problems should normally be simulated with a Fortran program.

CSMP III with the graphics feature is available in both CMS and MVS batch. However, User Services provides only minimal assistance for CSMP. For more information, enter (in CMS):

```
HELP CSMP
```

For an introduction to CSMP, read the article "CSMP" in *Simulation*, Volume 34, No. 4 (April 1980).

Transient Heat Transfer, Version B

The Transient Heat Transfer, Version B (THTB) is a program originally developed by General Electric to analyze general three-dimensional heat-transfer systems through a finite-difference method. The modes of heat exchange treated by the program are conduction, convection, gray-body diffuse radiation, surface flux, internal generation, non-sink mass flow, and latent heat effects. The basic function of the program is to set up the general heat-balance equation for each node point, to compute the terms that apply from the input given, and to solve the resulting set of equations.

THTB is available in MVS batch; however, User Services provides only minimal assistance for THTB. For further information, enter (in CMS):

```
HELP THT
```

For an introduction to THTB and a description of its usage at Argonne, see *THTB at ANL* (TM 281).

MATHEMATICAL LIBRARIES

Five major libraries of packaged mathematical software are available at ANL: the IMSL library, the NAG library, the DOE SLATEC library, the AMDLIB library, and the CERNLIB library. The more than one thousand subroutines in these five libraries implement many different numerical and statistical algorithms; the libraries are well tested, well documented, and well maintained. Since producing high-quality numerical software requires a thorough understanding of numerical algorithms, machine hardware structure, and programming language features, we recommend that you make a complete investigation of the packaged software available in these libraries before writing your own. There is considerable overlap among these libraries, and each has its own areas of strength and weakness. *Guidelines for Using the AMDLIB, IMSL, and NAG Mathematical Software Libraries at ANL* (ANL-81-73) describes the use of those libraries at Argonne; discusses the various subroutines available; and provides recommendations based on performance, applicability, storage requirements, ease of use, and the level of assistance. Documentation for the SLATEC library is available online in VAX/VMS through the MATHDOC program (see "The DOE SLATEC Library" below).

The International Mathematical and Statistical Library

The International Mathematical and Statistical Library (IMSL), available in CMS, MVS batch, UNICOS, and VAX/VMS, is a commercial library of about 350 Fortran-callable subroutines covering the following subjects:

Analysis of Variance
Basic Statistics
Categorized Data Analysis
Differential Equations, Quadrature, and
   Differentiation
Eigensystem Analysis
Forecasting, Econometrics, Time Series,
   and Transforms
Generation and Testing of Random Numbers
Interpolation, Approximation, and Smoothing
Linear Algebraic Equations
Mathematical and Statistical Special Functions
Non-Parametric Statistics
Observation Structure, Multivariate Statistics
Regression Analysis
Sampling
Utility Functions
Vector, Matrix Arithmetic
Zeros and Extreme Linear Programming

For further information, see the *IMSL Library Reference Manual*, available on fiche at the Document Distribution Counter.

The Numerical Algorithms Group Library

The Numerical Algorithms Group (NAG) library is a comprehensive collection of algorithms for the solution of numerical problems available in CMS, MVS batch, UNICOS, and VAX/VMS. The NAG library covers the following subjects:

Analysis of Variance
Complex Arithmetic
Curve and Surface Fitting
Correlation and Regression Analysis
Determinants
Differential Equations and Differentiation
Eigenvalues and Eigenvectors
Integral Equations
Interpolation
Matrix Operations
Minimizing and Maximizing a Function
Non-Parametric Statistics
Operations Research
Orthogonalization
Quadrature
Roots of One or More Transcendental Equations
Random Number Generators
Simultaneous Linear Equations
Simple Calculations on Statistical Data
Summation of Series
Time Series Analysis
Utility Functions
Zeroes of Polynomials

For further information, see the *NAG Fortran Library Manual.*

The DOE SLATEC Library

The SLATEC mathematical subroutine library is available in UNICOS and VAX/VMS. The program MATHDOC (in VAX/VMS) provides quick access to online information on SLATEC. To invoke MATHDOC, enter (in VAX/VMS):

MATHDOC

Use online HELP for assistance.

The SLATEC library includes:

- Elementary vector operations routines, including the basic linear algebra subroutines (BLAS) package.

- Solution of systems of linear equations, QR decomposition, and singular value decomposition routines (including the complete LINPACK package).

- Eigenanalysis routines (including the EISPACK2 package).

- Interpolation and quadrature routines (including the PCHIP package).

- Routines for solving nonlinear equations.

- Optimization routines (including the SPLP code).

- Numerical evaluation of definite integrals (quadrature) routines containing QUADPACK.

- Ordinary differential equation routines (including the DEPAC software interface).

- Partial differential equation routines (including the FISHPACK collection).

- Fast Fourier transforms routines (including the FFTPACK package).

- Approximation routines (including some MINPACK codes for nonlinear least squares).

- Pseudo-random number generation routines from FNLIB.

- Sorting routines.

- Elementary and special function routines (including the FNLIB collection of special functions and parts of the AMOSLIB and FUNPACK collections).

The AMDLIB Library

The AMDLIB library (available in CMS and MVS batch) consists of about 300 subroutines, most of which have been locally developed. The areas covered are:

Curve Fitting and Optimization
Differential Equations
Eigenvalues and Eigenvectors
Elementary Functions
Linear Algebra
Multiple-Precision Floating-Point Package
Numerical Differentiation
Polynomials and Special Functions
Quadrature
Random Numbers
Service Routines of Sorting, Timing, and
    Dynamic Memory Management

To obtain a list of the contents of AMDLIB, see *Kwic Index and Cross Reference Charts for the ANL Mathematical Subroutine Library* (Technical Memorandum 261) or enter (in CMS):

HELP AMDLIB MENU

To get the write-ups, enter (in CMS):

HELP AMDLIB routinename

where "routinename" is the routine for which you want information. To get the source code, invoke the Z-disk exec **AMDSOURCE**. For documentation of AMDLIB routines, enter (in Wylbur):

HELP AMDLIB

AMDLIB includes four special subroutine libraries: Eispack, Linpack, Minpack, and Funpack.

Eispack is a package of 58 Fortran subroutines primarily designed for finding eigenvalues and eigenvectors of matrices and matrix systems. For further information on the content and usage of the Eispack routines, enter (in CMS):

HELP AMDLIB EISPAC

Linpack is a collection of Fortran subroutines that analyze and solve various systems of simultaneous linear algebraic equations. These subroutines are designed to be completely machine-independent, to be fully portable, and to run at near-optimum efficiency in

most operating environments. Modified versions of BLAS are also included in this package. For further information on Linpack, see the *Linpack User's Guide* (0-89871-172-X).

Minpack is a package of Fortran subroutines for the numerical solution of systems of nonlinear equations and nonlinear least-squares problems. For further information, see the *User Guide for Minpack-1* (ANL-80-74).

Funpack is a collection of Fortran subroutines for evaluating certain Bessel functions, complete elliptic integrals, and exponential integrals. These routines are highly machine-dependent; the versions in AMDLIB are optimized for use on IBM 360/370 computers. The National Energy Software Center has versions for CDC and Univac machines.

CERNLIB

The CERN Program Library (CERNLIB) is available on the central VAX cluster. CERNLIB is a collection of mathematical, statistical, and general-purpose routines used frequently by persons involved in nuclear and particle accelerator physics. Many programs are general-purpose and therefore are applicable to other areas of science and engineering.

LOCAL UTILITIES

Collections of miscellaneous utility programs are available to CMS, VAX/VMS, and MVS batch users.

CMS users can access a library of miscellaneous utility programs on the Z-disk. To get a list of the execs and programs available, link to the ZDISK by entering **ZDISK** and then print the file ZDISK INDEX Z.

For more information on the available tools, VAX/VMS users can enter (at the DCL prompt):

HELP@CVCUTIL

In addition to the standard MVS batch utilities documented in *MVS/370 Data Administration: Utilities* (GC26-4065-2), CTD provides MVS batch users with locally written procedures for managing disk and tape files. These are documented in *MVS Batch Utili-*

ties for File Management at ANL (ANL/TM 412). You can also invoke many of these utilities from Wylbur with the help of locally written public execs. To get a list of currently available Wylbur execs, enter (in Wylbur):

HELP EXECS

PROGRAMS AVAILABLE THROUGH THE NATIONAL ENERGY SOFTWARE CENTER

The National Energy Software Center (NESC) maintains a computer program exchange and information center for the entire Department of Energy. To obtain a catalog of available NESC programs, contact the Argonne NESC office at extension 2-7250.

Department of Energy Order 1360.4 (February 2, 1983) on sharing computer software encourages DOE organizations and contractors to determine whether required software already exists or is under development before developing new software. DOE organizations and contractors can make this determination by consulting NESC or by reviewing descriptions of the Center's software collection.

Order 1360.4 also requires that DOE organizations and contractors provide NESC with the package material (e.g., source code, installation instructions, and user manuals) for software developed under departmental sponsorship and designated by the author as having value for other sites. DOE organizations and contractors may provide computer software directly to other DOE organizations and contractors on request for use in performing contract functions, if a copy is submitted to NESC at the same time that it is transmitted to the requester. Order 1360.4 specifies that distribution outside the department must be through NESC or the appropriate DOE-sponsored specialized computer software center and that requests from outside the department must be referred to NESC or the appropriate specialized center.

Under an Interagency Agreement, the National Technical Information Services (NTIS) now announces and markets the NESC software collection.

Copies of Order 1360.4 and of information on the established procedures for contributing software are available from NESC (Building 201, Room 240, extension 2-7250).

CHAPTER 5

PROGRAMMING LANGUAGES

HIGH LEVEL LANGUAGES AVAILABLE

High level programming languages available at Argonne include Basic, C, Cobol, Fortran, Pascal, PL/I, and Speakeasy. Extensive vendor documentation is available for all language processors. To learn more about how to invoke these language processors at Argonne, MVS batch users should read *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1), CMS users should read *CMS at ANL* (ANL/TM 423, REVISION 1), VAX/VMS users should read *Using the Central VAX 8700 Computer at ANL* (ANL/TM 455, REVISION 1), and UNICOS users should read Appendix E of the *UNICOS Primer* (SG-2010). Table 6 lists the languages and compilers available in these services.

Table 6 Languages Available at ANL				
Language	CMS	MVS Batch	VAX/ VMS	UNICOS
Basic	X		X	
C	X		X	X
Cobol		X		
Fortran	X	X	X	X
Pascal	X		X	X
PL/I	X	X		
Speakeasy	X			

Basic

Basic is an interpreted language that emphasizes ease of learning and use; it is especially appropriate for those just learning to write programs. Because Basic is interpreted (rather than compiled), each line can be entered individually to allow the interpreter to execute it and check it for errors.

A Basic interpreter is available in CMS. To compile a Basic program, enter (in CMS):

BASIC

When you use the interactive Basic interpreter, you can use extensive HELP for commands and Basic language statements. You can write Basic programs that call subprograms compiled with the VS Fortran compiler or subroutines that were compiled with the PL/I Optimizing Compiler (but not both in the same program). For more information on Basic, enter (in CMS):

HELP BASIC

In VAX/VMS, there is also an interactive Basic interpreter. There is no Basic compiler in VAX/VMS. For more information on Basic, enter (in VAX/VMS):

HELP BASIC

User Services has no plans to teach Basic courses; regular college courses and books are available outside the Laboratory. CMS users interested in Basic should see *IBM Basic Application Programming: Language Reference* (GC26-4026), *IBM Basic Application Programming: Guide* (SC26-4027), and *IBM Basic/VM Application Programming: System Services* (SC26-4028).

C

C is a general-purpose programming language that is powerful and easy to learn and use. It is similar to Pascal in that it features structured programming constructs, but C is more powerful since it can be used to perform assembler language functions and system calls. However, you must be careful when coding programs in C, because the compiler does not check for errors (e.g., mismatched variable declarations). C can be used for any application; however, it is especially useful for programs that require dynamic memory allocation, low level system calls, and high level structured programming constructs. In addition, programs written in C are portable, making it easy for users to share public domain C programs and to use programs written at other institutions.

The C programming language is available to CMS, UNICOS, and VAX/VMS users. For more information on how to use the C compiler, enter (in CMS):

    HELP IBMC

For more information on how to use the C compiler, enter (in VAX/VMS):

    HELP C

The Cray C compiler has been extended to include Cray architectural features, program vectorization, and scalar optimization. Available documentation for CMS users includes the *C Language Manual* (SC09-1128-01) and the *C Compiler User's Guide for VM/CMS* (SC09-1130-01). Available documentation for UNICOS users includes the *Cray Computer Systems: Cray C Reference Manual* (SR-2024) and the *Cray X-MP and Cray-1 Computer Systems: C Library Reference Manual* (SR-0136). The *Guide to VAX C* (AA-L370D-TE) for VAX/VMS users is available for reference in the CTD Systems Library. CTD will order it on request.

Cobol

The IBM VS version of the Cobol language is available at Argonne. It is oriented toward business programming applications in which file handling and output reports play a more significant role than numerical calculations. The User Services consultants provide very minimal assistance to Cobol users based on our limited experience. If you require in-depth Cobol assistance, arrange for a service request from MIS.

Fortran

Argonne researchers and technicians frequently use Fortran for scientific applications that require mathematical computations or other manipulations of numerical data. Because many scientific institutions around the world use Fortran and Fortran compilers are available on most computers, Fortran programs are usually transportable (with some modifications) from one machine to another. Fortran also comes with an extensive standard library of mathematical subroutines.

Fortran compilers conforming to ANSI X3.9-1978 (Fortran 77) are available in CMS, MVS batch, UNICOS, and VAX/VMS. (These compilers also accept Fortran programs written in the obsolete Fortran 66 standard.) The VS Fortran compiler on the IBM systems surpasses older IBM Fortran compilers in its debugging and optimizing capabilities. CTD recommends that you use the Fortran 77 standard when writing Fortran programs. Fortran 77 compilers are now available on a wide variety of large mainframe computers, on most minicomputers, and on some microcomputers.

Table 7 describes the names of the Fortran compilers and access to online HELP.

Table 7 **Available Fortran 77 Compilers**		
	Compiler Name	**Online HELP**
Cray UNICOS	cft77	man cft77
CMS	FORTVS	HELP FORTVS
VAX/VMS	FORTRAN	HELP FORTRAN

In MVS, there are different procedures for each version of Fortran and each Fortran compiler. For example, to invoke the VS Fortran compiler to compile, load, and execute your Fortran 77 program, use a cataloged procedure with the prefix "FORTV" (e.g., FORTVCLG).

The following Fortran compilers are also available to Argonne IBM users: Fortran G1, Fortran H Extended, and Fortran H Extended Enhanced. These compilers conform to the obsolete ANSI X3.9-1966 standard (also known as Fortran 66).

For users of CMS and MVS batch, we recommend the VS Fortran compiler to run debugged code that is ready for production. This compiler generates highly optimized code, greatly reducing the time that your job takes to execute and thus your cost. CTD no longer maintains the other Fortran compilers, though they are still available. If you are writing Fortran programs for a compiler other than the VS Fortran compiler, you should consider switching to the VS Fortran compiler to improve the execution of your programs and to have available maintenance and programming assistance.

The two Fortran-compatible compilers available in UNICOS are cft and cft77. Cft is the original Cray Fortran compiler. It is written in assembler language for compact memory use and rapid compilation and has benefited from about 15 years of development, but it has proved difficult to maintain and upgrade; therefore, Cray will provide all new developments in cft77. Cft77 is written in Pascal, so it is easier to modify and maintain, but it is much larger and slower than the original cft compiler. However, cft77 promises to produce much more efficient compiled object code than cft. The two compilers accept much of the same language.

You may mix subprograms compiled by cft with subprograms compiled by cft77 in the same executable image. A sensible strategy is to use cft when initially developing a program and then to switch to cft77 when the program nears completion. You can only determine the better compiler for an individual subprogram by trial and error. For more information, see the *Cray X-MP and Cray-1 Computer Systems: Fortran (CFT) Reference Manual* (SR-0009) and the *CFT77 Reference Manual* (SR-0018 C).

Pascal

Pascal is an intermediate language that contains most of the major features of the programming language ALGOL. It features structured programming constructs, which allow programmers to write structured code easily and efficiently. It was designed to be used as a teaching tool; therefore, Pascal programs are often easier to understand and maintain than programs written in other languages.

A Pascal language compiler is available in CMS and VAX/VMS. To use the IBM Pascal/VS program, enter (in CMS):

PASCALVS

For more information on its use, enter (in CMS):

HELP PASCALVS

To use the VMS Pascal compiler, enter (in VAX/VMS):

PASCAL

For more information on its use, enter (in VAX/VMS):

HELP PASCAL

The UNICOS Pascal compiler is a Level 1 ISO 7185 standard compiler with Cray extensions for array processing, multiple integer data types, compile time data initialization, additional library functions and procedures, and in-line procedures and function expansion. The Cray Pascal compiler performs some vectorization and scalar optimization but is inferior to Cray Fortran for numeric processing. Cray Pascal can call external routines written in either Pascal or Fortran.

IBM users should see the *Pascal/VS Language Reference Manual* (SH20-6168) and the *Pascal/VS Programmer's Guide* (SH20-6162). VAX/VMS users should see the *VAX Pascal User Manual* (AI-H485E-TE) and the *VAX Pascal Reference Manual* (AI-L369C-TE). UNICOS users should see the *Pascal Reference Manual* (SR-0060). The VAX/VMS and UNICOS documents are available for reference in the CTD Systems Library. CTD will order them on request.

PL/I

PL/I is an all-purpose language serving business, scientific, and systems applications. Business applications use its string-manipulation, editing, and file-handling capabilities. Its mathematical operations and extensive subroutine library function well with most scientific applications. The list-processing, multi-tasking, and teleprocessing capabilities are compatible with systems applications. The PL/I Optimizing Compiler is available to Argonne IBM users.

Speakeasy

Speakeasy is a language designed to provide straightforward access to and manipulation of data. Based on the concepts of arrays and matrices, it processes these as entities, thus eliminating the need for the loops necessary in other programming languages. It has a large vocabulary (over 800 words) of functions and commands, spanning the areas of set algebra, array manipulation, matrix algebra (including eigenanalysis), time series analysis, special mathematical functions, numerical integration and differentiation, statistics, graphics, and character processing. Speakeasy IV is available in CMS. For further information, enter (in CMS):

```
HELP SPEAKEZ
```

To use Speakeasy, enter (in CMS):

```
SPEAKEZ
```

Speakeasy has its own online HELP, which you can invoke once you are in Speakeasy. For detailed information on Speakeasy, see the *Speakeasy IV Reference Manual.*

ASSEMBLER LANGUAGES

Assembler languages are low-level, machine-oriented languages, unlike high-level, problem-oriented languages (e.g., Fortran and C). Assembler is generally chosen for systems applications or for small "modules" of a large program. Assembler language programs are generally compact and more efficient than those written in any of the high-level languages. However, assembler languages are highly machine-dependent; therefore, programs written in assembler for one computer are not transportable to another. In addition, assembler languages are more difficult to learn than higher-level languages and require much more effort to code. To minimize the amount of assembler language programming, we recommend writing programs in higher-level languages whenever possible. There are several assemblers at Argonne, available in CMS, MVS batch, UNICOS, and VAX/VMS.

The H-assembler provided in MVS batch contains significant extensions in the functions and features of the language. It is our most capable assembler, and we recommend it over the alternatives.

The IBM VS-assembler provided in MVS batch and CMS is a powerful macro assembler; programs using its more advanced features may not assemble successfully on other assemblers.

The VAX/VMS MACRO assembler will allow you to create macros within your assembler code. You can replace these macros with several assembler statements to simulate subroutine calls. For more information about the VAX/VMS MACRO assembler, see the *VAX MACRO and Instruction Set Reference Manual* (AA-LA89A-TE). This manual is available in the CTD Systems Library. CTD will order it on request.

The Cray Assembler Language (CAL) is provided in UNICOS. The CAL macro assembler allows precise access and control of all Cray architectural features. For more information, see the *Cray Computer Systems: CAL Assembler Version 2 Reference Manual* (SR-2003).

DEBUGGING AIDS

Several tools are available at Argonne to help you find errors in your programs. You will be more productive if you invest time in learning how to use these tools, rather than depending on the User Services consultants each time you run into difficulties.

VAX/VMS users can use the interactive VAX debugger to help check for programming errors. This debugger is not language-specific; therefore, you can use it to debug programs written in any of the languages available in VAX/VMS. During debugging sessions, you can set break points in the program, examine the source code as your program executes, execute the program one line at a time, and show the value of the program's variables at any point during execution. Many other capabilities of the debugger are documented in the *VAX/VMS Debugger Reference Manual* (AA-Z411C-TE).

When your MVS batch program terminates abnormally, the operating system issues a non-zero condition code and prints some traceback information. If you request a dump, the operating system will dump (print in hexadecimal) the storage area occupied by your program when the error occurred. With some experience, you will be able to use this information to determine the source of your error. For further information, see Appendix B of *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1).

UNICOS provides several debugging aids for static, batch dynamic, and interactive debugging:

adb   a general-purpose debugger that examines files and provides a controlled environment in which to execute UNICOS programs.

cdbx   a tool that performs source-level debugging and execution of programs under UNICOS. Provides the capability for X Window interactive debugging sessions.

dda   a dynamic dump analyzer that will interactively debug program memory dumps.

drd   a dynamic run-time debugger that will debug executing programs in batch or interactive mode.

debug   a core analyzer that will provide a traceback of a program and interpret the program memory in source language symbols.

symdebug   a symbolic debugger that interprets the memory of a running program. Use **symdump** instead. To ease conversion from the Cray Operating System (COS), **symdebug** is available. In UNICOS, **symdump** is preferable.

symdump   a symbolic debugger that interprets the memory of a running program.

For information on these debugging aids, see the *UNICOS User Commands Reference Manual* (SR-2011 5.0). For information on **symdebug** and **symdump**, see the *Cray Computer Systems: Symbolic Debugging Package Reference Manual* (SR-0112).

CHAPTER 6

GRAPHICS

This chapter provides a short overview of Argonne computer graphics and plotting capabilities. For more detailed computer graphics information, see the Argonne addendum to the *CA-Cuechart User's Guide 2.0* (RG 99 CC 2001S), the Argonne addendum to the *CA-Tellagraf User's Manual: Version 6.1* (RG 99 TG 6101S), the *ANL Supplement to the CA-Disspla User's Manual* (ANL/TM 467), and *Using the Apple LaserWriter at ANL* (ANL/TM 452).

COMPUTER GRAPHICS SOFTWARE

Of the graphics packages that are available at Argonne, some are standalone packages that you invoke interactively in CMS or VAX/VMS; therefore, you do not need to write a program to use them. Our most popular packages in this category are Cuechart and Tellagraf, both from Computer Associates (CA), and SAS/Graph. The Data Connection software package (also from CA) allows you to extract data from tabular report files and data files for input to Tellagraf.

Other packages consist of libraries of graphics subroutines that you can call from Fortran or PL/I programs. Our most sophisticated and powerful package in this category is Disspla (from CA). The Speakeasy language (available in CMS and MVS batch) also offers some graphics capabilities. Several other graphics packages are available for special purpose graphics applications. Table 8 shows the graphics software packages available at Argonne.

Cuechart

Cuechart is a proprietary software package (designed as an aid to chart making) available in CMS and VAX/VMS. It is a cue-and-response program for use as an aid to creating bar charts, line charts, pie charts, and word charts. Cuechart is designed for users

with no previous graphics experience, but experienced Tellagraf users can also use it to produce a chart quickly that can later be enhanced with Tellagraf. Cuechart gives you many Tellagraf capabilities without your having to learn Tellagraf commands. To obtain additional information, enter (in CMS):

HELP CUECHART

The *CA-Cuechart User's Guide 2.0* (RG 99 CC 2001S) and the *Cuechart Stencil Maker's Guide* contain documentation for Cuechart; an Argonne addendum to the *CA-Cuechart User's Guide 2.0* contains local information on the implementation.

Table 8	
Graphics Software Available on Central Argonne Computers	
Graphics Package	**Where Available**
Cuechart	CMS, VAX/VMS
Tellagraf	CMS, VAX/VMS
Data Connection	CMS, VAX/VMS
Disspla	CMS, MVS batch, UNICOS, VAX/VMS
SAS/Graph	CMS, MVS batch, VAX/VMS

Tellagraf

Tellagraf is a powerful conversational graphics package available in CMS and VAX/VMS. You do not need to write a program to make a graph; instead, you converse with Tellagraf from your terminal in quasi-English commands. With only a little training, scientists, administrators, and secretaries can produce sophisticated publication-quality plots.

For drawing a plot (log or linear), a bar chart, a pie chart, a table, or a page of text (e.g., a poster), consider Tellagraf as your first choice.

To get information on using Tellagraf at Argonne, enter (in CMS and VAX/VMS):

```
HELP TELLAGRAF
```

The *CA-Tellagraf User's Manual: Version 6.1* (RG 99 TG 6101S) gives a detailed description of the Tellagraf language. An Argonne addendum to the *CA-Tellagraf User's Manual: Version 6.1* contains information on Tellagraf's implementation at Argonne.

Data Connection

The CA Data Connection software package is available in CMS and VAX/VMS. You can use the Report Connection (REPCON) and the File Connection (FILCON) to extract data from reports or files for input to Tellagraf. REPCON and FILCON can be especially useful for extracting data produced by a program whose source code either is not available to you or is inconvenient to change to incorporate graphics. The Decision Support Connection is an extension within Tellagraf that allows you to manipulate your data by using various editing, mathematical, and statistical functions and commands with verification capability. The External Program Connection allows communication between the Tellagraf module and your external application programs (e.g., Fortran or SAS).

For more information about REPCON, enter (in CMS and VAX/VMS):

```
HELP REPCON
```

For more information about FILCON, enter (in CMS and VAX/VMS):

```
HELP FILCON
```

For more information, see the *Data Connection User's Guide.*

Disspla

The Disspla package is a versatile, sophisticated graphics package available in CMS, MVS batch, UNICOS, and VAX/VMS. This software package consists of several hundred Fortran-callable and PL/I-callable subroutines that enable you to obtain professional quality plots. It offers all that Tellagraf offers and more. In addition to plots (log or linear), bar charts, pie charts, and pages of text, it also provides subroutines for contour plots, 3-D plots, world maps, and movies. Moreover, it provides greater flexibility for tailoring your graphs than Tellagraf does. However, you will have to write a Fortran or PL/I program to invoke the appropriate Disspla subroutines, and you will have to invest a fair amount of time learning to use Disspla (note that PL/I is not available in VAX/VMS). For information on using Disspla at Argonne, enter (in CMS):

```
HELP GRAPHICS DISSPLA
```

For information on using Disspla at Argonne, enter (in VAX/VMS):

```
HELP DISSPLA
```

For a detailed description of the Disspla subroutines, see the *CA-Disspla User Manual: Release 11.0* (RG 99 DS 1101S) or the *ANL Supplement to the CA-Disspla User's Manual* (ANL/TM 467).

SAS/Graph

SAS/Graph (available in CMS, MVS batch, and VAX/VMS) is an option of SAS. It consists of a variety of graphical procedures that are invoked in the same manner as other SAS procedures. SAS/Graph can produce black-and-white or color plots and charts on graphics terminals, plotters, or other hardcopy devices. In addition to plots and charts, you can produce block charts, pie charts, star charts, two-dimensional plots, three-dimensional surfaces, and contour plots. While CTD recommends Tellagraf (and its Cuechart interface) and Disspla for most graphics users, SAS users can benefit from using SAS/Graph to develop graphics output for their SAS applications.

For more information on using SAS/Graph at Argonne, see the *SAS/Graph User's Guide Version 5 Edition* (0-917382-68-4) and the Argonne addendum to the *SAS/Graph User's Guide Version 5 Edition*.

GRAPHICS PLOTTING DEVICES

Several different types of graphics plotting devices are available at Argonne.

While designing and debugging programs with graphics output, you should use a graphics terminal to develop plots. Graphics terminals are located throughout the Laboratory and are usually owned and maintained by the divisions in whose buildings they are located.

Users who do not have access to a graphics terminal may use one of the Apple LaserWriters distributed around the Laboratory. The Apple LaserWriter is a PostScript printer that is compatible with many graphics software packages (e.g., Cuechart, Tellagraf, Disspla, SAS/Graph, Apple Macintosh applications, and some other personal computer applications). See "Output Devices" in Chapter 1 for a description of the Apple LaserWriter and its capabilities and *Using the Apple LaserWriter at ANL* (ANL/TM 452) for information on how to use it.

Once your graphics program is debugged, you have a choice of several output devices (depending on your application). The CalComp 5835 XP color electrostatic plotter in Building 221 will do large format color graphics. For high quality gray scale printing, you can use the Linotype L300P typesetter in Building 222. For descriptions of these devices, see "Linotype L300P Typesetter" and "CalComp Color Plotter" in Chapter 1.

The Matrix camera is available as a high quality graphics output device for making full-frame color 35mm slides. It is a raster device (a device that generates an image by using a line-by-line scanning technique) with no color mixing attributes. You can also make eight-by-ten inch viewgraph acetate slides.

For advice in selecting graphics terminals, call the User Services Consulting Office at extension 2-5405.

SCIENTIFIC VISUALIZATION EXTENDS COMPUTER GRAPHICS EFFORTS

Like many other research centers, ANL is launching a new initiative to pursue state-of-the-art scientific computer graphics capabilities by organizing a Scientific Visualization Facility. Scientific visualization is the depiction of quantitative scientific information through computer graphics for analysis of complex simulations or equations. Three-dimensional, time-dependent graphic representations and animation sequences can effectively depict dynamic processes, evolutionary progressions, and object interactions far more effectively than words or conventional graphics.

CTD has been collaborating with ANL divisions to develop visualization tools for scientific research. Recent visualization projects include computational fluid dynamics, animating the combustion of solid and gaseous fuels, analyzing and reconstructing three-dimensional images from electron microscopy data, analyzing deflections and reflections of high energy beams through the 1-2-3 superconducting lattice structure, and visualizing electron fields within dense helium liquid. While computations are often performed with supercomputers and parallel processors, much of the visualization is done locally with an Ardent Titan supergraphics workstation and a low-cost video equipment configuration.

CTD also provides graphics programming services for developing graphics tools with the Disspla graphics library. The resulting graphics programs can be used with the Cray X-MP/14, VAX 8700, IBM computers, divisional VAX computers, and other systems with Disspla.

Limited funding for CTD effort for visualization projects was provided through Laboratory discretionary funds. To meet the anticipated growth in demand and to ensure timely progress for projects, CTD plans to increase available visualization efforts with the following funding from ANL divisions: (1) a visualization staff, (2) funding for visualization graduate students, and (3) service requests. Some ANL divisions have developed proposals for computational research that incorporate a visualization component with CTD collaboration. CTD will continue to explore opportunities for joint proposals with ANL divisions. CTD directions for this activity are documented in *A Plan For Scientific Visualization at ANL* (ANL/TM 476).

To obtain graphics programming services or to discuss possible collaborations, contact the User Services manager at extension 2-7419.

VISUAL ANALYSIS OF DATA WITH NCSA IMAGETOOL

Computer users with programs that store or represent results in a two-dimensional array may benefit from visually analyzing that data with the NCSAImage program for the Apple Macintosh II, ImageTool for the Sun computers, or the PCShow program for the IBM personal computers. These programs were developed at NCSA at the University of Illinois at Urbana-Champaign. They allow you to visualize your data as raster images on your screen. They also allow you to use different color palettes, to magnify images, and to animate multiple raster images. Other options (depending on the machine for which it is written) also help analyze data.

These programs vary according to the machine on which you work. Table 9 provides a comparison.

Table 9 **NCSA ImageTool Functions**			
Functions	Mac II	IBM PC	Sun
Modify and save color palettes	X		X
Magnify images	X	X	X
Use color, contour, three-dimensional, shared data, dither plots, and XY graphs	X		X
Print contour, stored data, dither plots, and XY graphs	X		X
Animate multiple raster images	X	X	X

Each program requires different hardware:

- NCSAImage for the Apple Macintosh requires:

    1. An Apple Macintosh II with 256-color capabilities.

    2. System software update Version 5.0 or later.

    3. More than one megabyte of random-access memory (RAM).

- PCShow for the IBM Personal Computer requires:

    1. An IBM PC, PC-AT, PC-XT, or PS/2.

    2. An Enhanced Graphics Adapter (EGA), a Video Graphics Adapter (VGA), or a Revolution 512 (NO9) graphics card.

    3. A minimum of 320K memory.

    4. PC DOS or MS DOS Version 2.0 or later installed on the machine.

- ImageTool for the Sun requires:

    1. A Sun Workstation with color hardware capable of displaying 256 colors simultaneously.

    2. SUNVIEW (Visual/Integrated Environment for Sun Workstations) installed on the machine.

Documentation for these programs is available at the Document Distribution Counter.

Apple Macintosh II and IBM Personal Computer users can obtain copies of these programs at the Document Distribution Counter or by anonymous FTP to NCSA via the Internet network. Sun users must obtain a copy of ImageTool by anonymous FTP to NCSA. To copy the programs by FTP, enter (on a computer connected to the Internet network):

```
ftp 128.174.20.50
```

After you enter this command, the NCSA computer will prompt you for a username, to which you should respond:

```
anonymous
```

The NCSA computer will then prompt you for a password (your badge number). After logging in, issue the **dir** command to find the version of the program you want. Then use the ftp **get** command to copy the README file from the appropriate directory for your workstation. This file will explain which files you need, how to copy them to your machine, and how to construct an executable image from them.

CHAPTER 7

STORING YOUR DATA ON DISK AND TAPE FILES

If you are working with data files on the central Argonne computers, you will need to store those files on disks or tapes. This chapter describes briefly some CTD storage policies and procedures, how to obtain disks and tapes, and how to manage the files that you store on those disks and tapes.

MAINTAINING DATA INTEGRITY

We recognize the importance of preserving the integrity of your data files and have detailed procedures for protecting your data. Nevertheless, in spite of all our precautions, accidents do happen to tape and disk volumes that can damage or destroy data. *Remember that the ultimate responsibility for the integrity of your data lies with you, the owner and user.* You should develop good back-up and reconstruction methods commensurate with the value of your data.

You should follow certain general guidelines to ensure that your data is stored economically and safely. When you create new files, see the appropriate documentation for the computer system you are working on to learn how to avoid wasteful storage methods. If you have old files that you no longer access, discard them or transfer them to magnetic tape. Also, use tape rather than disk space for archiving files.

You may find that the system back-up procedures on the system you are using are adequate for your files. However, you should maintain your own back-up procedures for valuable files. If your files are damaged or destroyed, through either a system malfunction or human error (on your part or ours), you can request that they be restored from back-up tapes by contacting the Consulting Office at extension 2-5405. If the damage is the fault of CTD, you will not have to pay for the cost of running the job to restore the files from the back-up tape. However, regardless of how the data were damaged, CTD will not pay for the time and effort required to reconstruct lost or damaged data.

The central computers have no provisions for handling applications that use *classified* (as defined by DOE) data. We do provide protection for *sensitive data* (see "Obtaining Tapes and Managing Tape Files" below and the *RACF Summary for Central IBM Computers at ANL* (ANL/TM 478). If you are planning to put sensitive data on any of the central complex computers (or any other computers), you should contact the Laboratory's Computer Protection Program Manager (Building 221, Room A-237, extension 2-7440) or the Laboratory's Internal Auditing staff in the Office of the Director.

OBTAINING DISKS AND MANAGING DISK FILES

All the central computer systems have specific storage methods and policies. To establish an account or to modify your account storage limits, call Account Services at extension 2-5425. For specific information on storage in any of the systems, see the technical memoranda cited in each section below.

CMS Storage

Account Services assigns CMS users their own private sections of disks (called minidisks). All users are responsible for managing all the files on their minidisks. Users pay a monthly rental for the entire space on their minidisks, whether they use it all or not. You can use CMS commands to access large amounts of extra disk space temporarily (for the duration of a session). If you need more than 2.5 megabytes of minidisk space, you should apply for CMS Database Storage; your Region Manager will have to approve the request.[8] To get a new minidisk or to change the

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[8] Each cost center (division or other organization) at the Laboratory should appoint a Region Manager whose responsibilities include managing database storage space for which the organization has con-

amount of space on your minidisk, contact Account Services.

To see what disks you are linked to in CMS and to check the storage status of your CMS minidisk, enter (in CMS):

    QUERY DISK

For an alphabetical listing of the files on your minidisk, enter (in CMS):

    FILELIST

Or enter (in CMS):

    LISTFILE

By default, access to a minidisk is limited to the owner. The owner can gain read access to that minidisk with the RACFREAD exec. For more information, enter (in CMS):

    HELP RACFREAD

Each night, the central computer operators back up files that have been changed during a given day. On a weekly basis, the operators back up all CMS minidisks to tape. CTD preserves these weekly back-up tapes for three weeks before reusing the tapes. If you wish to further protect your files, use the **TAPE DUMP** command to back up all or part of your minidisk. For instructions on using this command and for more information on storage in CMS, see *CMS at ANL* (ANL/TM 423, REVISION 1).

If your minidisk is damaged or destroyed, you can request that it be restored from back-up tapes by filling out an "MVS Dataset/CMS Minidisk Restore Request Form," available from the Consulting Office.

IBM Virtual Storage Access Method (VSAM) data spaces for users are available in CMS on all volumes. VSAM provides a method for storing and accessing data (either sequentially or at random) on direct access devices. You can use VSAM with PL/I, VS Fortran, and assembler language programs. To learn more about VSAM, see the *VSAM Primer and Reference* (G320-5774). PL/I users should first consult the *OS PL/I Optimizing Compiler: Programmer's Guide* (SC33-0006).

MVS Batch and Wylbur Storage

MVS batch and Wylbur users can store their files on either temporary or permanent disks. Computer Operations erases files on temporary disks one week after they are created. Files on permanent disks remain online but are subject to migration (see "Conserving Space on MVS Public Disk Volumes" below). Account Services will charge you for the space your files occupy.

All datasets on PERM volumes (except those on database volumes) are backed up on tape weekly, and the tapes are usually retained for three weeks. If you wish to further protect valuable data, you can use the Wylbur exec **BACKUP** to copy your datasets onto tape. To learn how to use the **BACKUP** exec, enter (in Wylbur):

    HELP BACKUP

If your datasets are damaged or destroyed, you can request that they be restored from back-up tapes by filling out an "MVS Dataset/CMS Minidisk Restore Request Form," available from the Consulting Office.

For very large batch files that you access infrequently, use database storage to ensure that the files are available when you need them. Files in database storage are not subject to migration. Your Region Manager is responsible for managing this space, and Account Services will charge your organization a monthly rental for the entire amount of database space for which your organization has contracted. To apply for database storage, have your Region Manager fill out a "Database Storage Request Form" from Account Services.

IBM VSAM data spaces for MVS batch users are also available on specific database storage volumes. (For more information on VSAM, see "CMS Storage" above.) In addition to using VSAM with PL/I, VS Fortran, and assembler language programs, you can use

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tracted and approving CMS database requests from members of the organization.

it with VS Cobol programs in MVS batch. To avoid the allocation of multiple-volume VSAM datasets and the allocation of VSAM datasets on other MVS batch volumes, we restrict users from creating their own VSAM datasets in MVS. This restriction is necessary to avoid conflicts with our volume back-up and to restore procedures. Users with VSAM dataset needs in MVS batch should have their Region Manager complete a "Database Storage Request Form" from Account Services. CTD will then allocate the datasets on volumes reserved for this type of storage.

MVS batch users of Cobol who are interested in VSAM should see the *IBM OS/VS Cobol Compiler and Library Programmer's Guide* (SC28-6483). For more information on storage in MVS batch and Wylbur, see *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1).

Conserving Space on MVS Public Disk Volumes

CTD regularly removes inactive files from MVS disk storage to make room for the growth of active files and the creation of new files. The clean-up procedure for permanent MVS disks has two parts: migration and "squeezing." Files on the permanent public MVS disk volumes are eligible for migration to tape if they remain unused for a period of 60 days. To determine which of your files have been migrated to tape, enter (in Wylbur):

DO FINDDSN

To move a file from a migration tape back to an online disk, enter (in Wylbur):

DO LOADDSN

To delete unwanted offline datasets on tape, enter (in Wylbur):

DO PURGEDSN

To learn how to use these execs, enter (in Wylbur):

HELP FINDDSN

Or enter (in Wylbur):

HELP LOADDSN

Or enter (in Wylbur):

HELP PURGEDSN

Files active enough to remain online but still containing unused space are subject to compression and release of unused space for use by others. CTD performs this activity occasionally, depending on disk storage availability.

VAX/VMS Storage

Two classes of disk storage (permanent and temporary) are available for VAX/VMS users. A standard VAX/VMS account provides 20 megabytes of permanent disk space and about 120 megabytes of temporary disk space. If you need additional space, you can apply for it when you establish your account, or later when your needs exceed your current storage. CTD backs up files daily in both permanent and temporary storage to protect against accidental loss of data. Files in temporary storage that are "older" than seven days are deleted; files in permanent storage are deleted only by their owners.

To ensure that user files are protected from unauthorized access, CTD has established a default file protection for VAX/VMS files; unless you change the protection on a file, it is not accessible by users in your "group" (cost center) or the "world" (all other non-privileged users). For specific information on file protection, see the DEC *Guide to VAX/VMS System Security*. See also *Using the Central VAX 8700 Computer at ANL* (ANL/TM 455, REVISION 1).

UNICOS Storage

UNICOS offers three classes of disk storage: NORMAL, SHORT, and SCRATCH. (A fourth class, */tmp*, is used by many UNICOS programs and is cleaned up automatically every time the system is restarted.) NORMAL is a small storage class whose files are kept indefinitely. SHORT is a large storage class whose files are normally removed after they are not accessed for several days (a minimum of one working day). SCRATCH is a large storage class whose files are normally removed when the job that created them terminates. You can access these storage classes through the $NORMAL, $SHORT, and $SCRATCH shell variables, which contain the UNICOS directories of the respective storage classes.

To protect files from unauthorized access, CTD has established a default file access that gives the owner of a file read and write permission and gives the owner's "group" and all "others" no access. Use the chmod command to alter the permission of any file you own.

UNICOS disk files are backed up to tape on a weekly basis. If you have files for which you want additional or more frequent protection, you should transfer them to the system through which you are accessing UNICOS (MVS batch or VAX/VMS) and use the back-up and protection procedures available in that system.

NETWORK FILE SYSTEM FOR CRAY SUPERCOMPUTER

The Network File System (NFS), developed by Sun MicroSystems, Inc., allows computers to access disk files of other computers in a transparent manner. Workstation users can access files on a remote server as if those files reside locally on the workstation. Multiple workstations can share the same file systems on a file server, and multiple file servers can be accessed by a single workstation.

NFS can be used in a network with independently administered systems. To ensure authorized access, Cray users must first identify which nodes and userids may access their data stored on Cray disks.

Using NFS has less impact on the Cray performance than an interactive session on the Cray. With NFS, it is possible for a user to edit UNICOS files from the workstation rather than to edit interactively on the Cray. This technique will avoid swapping and interrupt processing overhead and will cost much less than interactive editing of the file on the Cray.

OBTAINING TAPES AND MANAGING TAPE FILES

Magnetic tape reels and cartridge tapes are available for storing large sequential datasets. Archival datasets and back-ups of your disk datasets should also be stored on tape. Tape storage is usually less expen-

sive than disk storage, and the 38,000 bits-per-inch and cartridge tape drives will transfer data quickly.

CTD uses the CA-1 tape library management system to manage tapes automatically; to protect against accidental destruction; and to provide timely online inquiry, updating, and summary reporting of tape status. You may use "library" tapes (which must remain stored in the tape library), or you may bring in your own tape reels (these tapes are "personal" tapes that you store yourself, except when you bring them to the Computer Output and Document Distribution Area in A-134 for processing). Whenever you submit a job that needs a new tape, you will have a library tape assigned to you automatically. To produce a report of tapes assigned to you, enter (in CMS and VAX/VMS):

TAPELIBR

Or enter (in Wylbur):

DO TAPELIBR

For information on CA-1, see *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1).

CTD does not make back-up copies of user tapes. You should maintain your own back-up copies of important tape files. CTD provides a remote vault for disaster back-up storage of critical tapes. For details, see *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1). Services are available (for a specified charge) for cleaning and testing new or used personal tapes.

CTD provides RACF protection for labeled tapes in MVS batch. Also, operators use RACF to verify authorization to mount tapes on the VAX or Cray systems or to remove tapes from the CTD library. However, the tape is not verified by RACF on the system when it gets mounted. RACF protects entire tape volumes, not individual tape datasets. One can establish RACF protection only in MVS batch or by contacting the CTD Computer Protection Program Manager. To learn how to use RACF commands to protect your tapes, see *MVS RACF Command Language Reference* (SC28-0733) and *MVS Batch Computing and Data Management at ANL* (ANL/TM 400, REVISION 1).

CHAPTER 8

YOUR USER VOICE

The quality of Argonne's computing services depends to some extent on users voicing both their pleasure and their dissatisfaction with those services. To meet your expectations, CTD especially needs information from users about difficulties with the various systems. Please communicate such "bugs" to the User Services consultants at extension 2-5405 and, when appropriate, on a "Problem Report" form available in the Consulting Office (Building 221, Room A-139).

Another avenue open for voicing your opinions is through the various computer-related committees and subcommittees of the Argonne Computer Users Group (CUG) and through the Computing Policy Committee (CPC).

THE COMPUTER USERS GROUP

The CUG regularly meets on the first Tuesday of each month at 3:00 p.m. in various buildings. At these meetings, CTD staff and CUG attendees discuss proposed improvements to the services, plans for new services, projected policy changes and enhancements to the computing systems, and other relevant issues. Attendance at CUG meetings and the meetings of its subcommittees is open to all interested persons. To have your name placed on the mailing list, call the CUG secretary. To have an item placed on the agenda for the next meeting, call the CUG chair. See Table 10 for a list of CUG officers.

COMPUTING POLICY COMMITTEE

The CPC formulates Argonne's overall computing policy and approves scientific and administrative computing plans for individual divisions and for Argonne as a whole. The Committee approves the Laboratory's annual *ANL Site Response for the DOE Information Technology Resources Long-Range Plan* before it goes to DOE. The Committee approves the acquisition of all computing equipment costing over $50,000 and all software costing over $25,000.

The CPC establishes equitable policies for allocation of the resources of the Laboratory's shared computational facilities and for the recovery of costs associated with the Laboratory's computing services. The Committee also addresses such issues as the standardization of computing hardware and software, new acquisitions and maintenance, and organizational modifications to capitalize on technology and economies of scale.

The Committee usually meets once a month. See Table 11 for a list of the committee members.

OTHER INFORMAL INTEREST GROUPS

In addition to the formal CUG and its subcommittees listed in Table 10, there are several informal interest groups at the Laboratory (see Table 12). If you are interested in any of these groups, call the appropriate chair for information.

Table 10

Computer Users Group Officers

CUG Officers		
Chair	Dotti Bingaman	972-3978

CUG Subcommittee Chairs		
Data Management Subcommittee	Bert Toppel	972-4815
Distributed Computing Subcommittee	Steve Gabelnick	972-4365
Graphics Subcommittee	Mary Snider	972-3775
Installation Advisory Subcommittee	Dotti Bingaman	972-3978
Personal Computer Subcommittee	Ken Miller	972-7676
Timesharing Subcommittee	Steve Pieper	972-4232

Table 11

Computing Policy Committee Members

Joseph Asbury, Chair	Strategic Planning
Clarence Beck	Argonne West
Dotti Bingaman	Environmental Assessment and Information Sciences
Jim Boyle	Mathematics and Computer Science
Edward Croke	Energy, Environmental and Biological Research Program Administration
Paul Day	Chemistry
Martin Knott	Advanced Photon Source
Dale Koelling	Materials Science
John Marchaterre	Reactor Analysis and Safety
Jim O'Kelley	Chief Financial Officer
Larry Price, Chair, Networking Subcommittee	High Energy Physics
Jack Shannon	Environmental Research
Richard Valentin	Materials and Components Technology
Dave Weber	Computing and Telecommunications

Table 12

Informal Interest Groups

ANL HP Desktop Computer Users Group	Ted Anderson	972-3071
ANL NBI Users Group	Jackie Griffith	972-3795
Argonne Personal Computer Club	Duane Bradley	972-7307
Connection Machine Users Group	David Levine	972-6735
Graphic Arts Users Group	Mary Warren	972-8719
Macintosh Users Group	Bob Kampwirth	972-5521
VAX System Managers	Paul Day	972-3681
3Com Administrators Group	Sue Long Marcia Wood	972-6618 972-6182

APPENDIX A

DIRECTORY OF IMPORTANT USER CONTACTS

This appendix lists user-related computing offices and services at Argonne. Unless otherwise specified, all room listings are in Building 221 (the location of CTD). All telephone numbers are extensions of the main Argonne National Laboratory number, (708) 972-2000. From onsite telephones, just dial the extension given; from offsite telephones, dial the 972 prefix with the extension. If you are not sure whom to call for your inquiry, call the User Services consultants in the Consulting Office at extension 2-5405.

Office/Area	Room	Phone	Service
Account Services	A-147	2-5425	To obtain, change, or terminate computing accounts.
CMS Operator	A-134	2-8442	To report CMS difficulties. To ask an operator to log you off a CMS session.
Computer Networks	B-243	2-5432	To help select telecommunications equipment.
Computer Operations	A-134	2-5421	To make inquiries about difficulties not addressed by the Current System Status Recorded Message.
Computer Operations Manager	A-113	2-5437	To schedule special job processing.
Computer Output Area	A-134	2-5421	To contact Computer Operations. To obtain distributed output. To obtain available documents from the Document Distribution Counter.
Computer Protection Program Manager	A-237	2-7440	To obtain advice on computer protection. To report computer security incidents.
Consulting Office	A-139	2-5405	To obtain general assistance and advice. To request refunds. To request that files be restored. To report system bugs.
Cray Operator	A-134	2-5421	To report difficulties with the Cray.

Current System Status Recorded Message		2-5466	To learn the status of the central computers.
Digital Instrumentation (Electronics Department, Building 222)		2-6972	To obtain consulting help with real-time systems and minicomputers.
Document Distribution Counter	A-134	2-5421	To obtain manuals.
Documentation Advice	A-139	2-5405	To order manuals. To sign up for computing courses.
Electronics Department (Building 222)		2-6931	To have terminals or computers repaired.
Management Information Systems	B-151	2-7156	To obtain administrative computing services.
National Energy Software Center (Building 201)	C-269	2-7250	To obtain DOE software exchange and distribution services.
Service Engineering	B-159	2-5427	To obtain maintenance and repair of remote job entry stations. To have terminals repaired.
Tape Librarian	A-134	2-7681	To release, secure, or purge library tapes.
User Services Manager	A-121	2-7419	To report complaints and suggestions. To get authorization for special job processing. To request contract programming.
VAX Operator	D-120	2-5238	To report VAX/VMS difficulties. To suggest improvements.

APPENDIX B

COMPUTER USAGE FORMS

This appendix lists and defines the various forms that Argonne computer users must complete during the process of applying for computing resources and accesses. You may pick up these forms from the location specified. Account Services is in Building 221, Room A-147 (extension 2-5425); the Consulting Office is in Building 221, Room A-139 (extension 2-5405); the Computer Output Area and the Document Distribution Counter are in Building 221, Room A-134 (extension 2-5421).

CMS File, VMS File, Cray File and MVS Dataset Restore:	For requesting restoration of a damaged or lost disk file or a CMS minidisk. Return to Consulting Office.
Computer Aided Engineering Usage Authorization Request:	For requesting account authorization for computer aided engineering usage. Return to Account Services.
Computer Materials Disposition:	For transferring or disposing of disk and tape files at termination. Return to Account Services.
Computer Refund Request:	For requesting a refund for jobs that failed because of circumstances beyond user control. Return to Consulting Office.
Documentation Request:	For requesting manuals at the Document Distribution Counter.
HRS Enrollment Request:	To use the Human Resource System. Return to Account Services.
IBM MVS Database Storage Request:	For requesting database disk storage on the MVS batch system. Return to Account Services.
Initial CMS Database Allocation Request:	For requesting a CMS minidisk larger than 2.5 megabytes. Return to Account Services.
MVS TSO Enrollment Request:	To use the TSO interactive service on the MVS batch system. Return to Account Services.
Problem Report:	To report computing difficulties or make suggestions for improving computing systems and services. Return to Consulting Office.
Request for Authorization of Computer Account:	To use the Cray X-MP computer, the IBM central computers (MVS batch and Wylbur or CMS), or the central VAX 8700 computer. Return to Account Services.

Tape Service Request: For purchasing a new or library tape; returning a tape for credit; and labeling, cleaning, or testing a tape. Return to the Computer Output Area.

Tymnet Access Request: To gain access to the Tymnet network. Return to Account Services.

APPENDIX C

ANL CHARACTER TRANSLATION TABLES

In May 1987, CTD revised its character translations between American Standard Code for Information Interchange (ASCII) and Extended Binary Coded Decimal Interchange Code (EBCDIC) to conform to what has become a *de facto* standard among many vendor products. This appendix lists the current character translations at ANL to map 130 EBCDIC characters into 128 ASCII characters (the left and right braces have two EBCDIC designations for compatibility with both the old and new standards). These translation tables are used whenever data from an ASCII device is transmitted to IBM equipment (which uses EBCDIC), and vice versa. Two complete translation tables are included: Table 13 for EBCDIC-to-ASCII translation, and Table 14 for ASCII-to-EBCDIC translation.

In translation from ASCII to EBCDIC, the 128 characters are mapped, regardless of parity (where appropriate), to 128 EBCDIC characters. In translation from EBCDIC to ASCII, the same 128 EBCDIC characters will map back into the 128 ASCII characters. The other 128 EBCDIC characters, which have no ASCII equivalent, are translated to a "don't care" condition and are usually replaced by the printable ASCII character "#."

The IBM 3800 laser printer has been set up to print the ASCII character representation. Additional EBCDIC characters are as printed or represented on a TN print train.

Table 13

ANL Character Translation Tables: EBCDIC to ASCII

EBCDIC HEX	CHAR	NAME	ASCII HEX	CHAR	NAME
00	NUL	Null	00	NUL	Null
01	SOH	Start of Heading	01	SOH	Start of Heading
02	STX	Start of Text	02	STX	Start of Text
03	ETX	End of Text	03	ETX	End of Text
05	HT	Horizontal Tab	09	HT	Horizontal Tabulation
07	DEL	Delete	7F	DEL	Delete
0B	VT	Vertical Tab	0B	VT	Vertical Tabulation
0C	FF	Form Feed	0C	FF	Form Feed
0D	CR	Carriage Return	0D	CR	Carriage Return
0E	SO	Shift Out	0E	SO	Shift Out
0F	SI	Shift In	0F	SI	Shift In
10	DLE	Data Link Escape	10	DLE	Data Link Escape
11	DC1	Device Control 1	11	DC1	Device Control 1
12	DC2	Device Control 2	12	DC2	Device Control 2
13	TM	Tape Mark	13	DC3	Device Control 3
16	BS	Backspace	08	BS	Backspace
18	CAN	Cancel	18	CAN	Cancel
19	EM	End of Medium	19	EM	End of Medium
1C	IFS	Interchange File Sep.	1C	FS	File Separator
1D	IGS	Interchange Group Sep.	1D	GS	Group Separator
1E	IRS	Interchange Record Sep.	1E	RS	Record Separator
1F	IUS	Interchange Unit Sep.	1F	US	Unit Separator
25	LF	Line Feed	0A	LF	Line Feed
26	ETB	End of Trans. Block	17	ETB	End of Trans. Block
27	ESC	Escape	1B	ESC	Escape
2D	ENQ	Enquiry	05	ENQ	Enquiry
2E	ACK	Acknowledge	06	ACK	Acknowledge
2F	BEL	Bell	07	BEL	Bell
32	SYN	Synchronous Idle	16	SYN	Synchronous Idle
37	EOT	End of Transmission	04	EOT	End of Transmission
3C	DC4	Device Control 4	14	DC4	Device Control 4
3D	NAK	Negative Acknowledge	15	NAK	Negative Acknowledge
3F	SUB	Substitute	1A	SUB	Substitute
40	SP	Space	20	SP	Space
4B	.	Period, Decimal Point	2E	.	Period, Decimal Point
4C	<	Less-than Sign	3C	<	Less-than Sign
4D	(	Left Parenthesis	28	(	Left Parenthesis
4E	+	Plus Sign	2B	+	Plus Sign
4F			Logical OR	7C			Vertical Line
50	&	Ampersand	26	&	Ampersand
5A	!	Exclamation Point	21	!	Exclamation Point
5B	$	Dollar Sign	24	$	Dollar Sign
5C	*	Asterisk	2A	*	Asterisk
5D	)	Right Parenthesis	29	)	Right Parenthesis
5E	;	Semicolon	3B	;	Semicolon
5F	¬	Logical NOT	5E	^	Circumflex
60	-	Minus Sign, Hyphen	2D	-	Minus Sign, Hyphen
61	/	Slash	2F	/	Slash
6B	,	Comma	2C	,	Comma
6C	%	Percent	25	%	Percent
6D	_	Underscore	5F	_	Underline
6E	>	Greater-than Sign	3E	>	Greater than
6F	?	Question Mark	3F	?	Question Mark
79	`	Grave Accent	60	`	Grave Accent
7A	:	Colon	3A	:	Colon
7B	#	Number Sign	23	#	Number Sign
7C	@	At Sign	40	@	Commercial At
7D	'	Prime, Apostrophe	27	'	Prime, Apostrophe
7E	=	Equal Sign	3D	=	Equals
7F	"	Quotation Mark	22	"	Quotation Marks
81	a	Lowercase A	61	a	Lowercase A
82	b	Lowercase B	62	b	Lowercase B
83	c	Lowercase C	63	c	Lowercase C
84	d	Lowercase D	64	d	Lowercase D
85	e	Lowercase E	65	e	Lowercase E
86	f	Lowercase F	66	f	Lowercase F
87	g	Lowercase G	67	g	Lowercase G
88	h	Lowercase H	68	h	Lowercase H
89	i	Lowercase I	69	i	Lowercase I
8B*	{	Opening Brace	7B	{	Opening Brace
91	j	Lowercase J	6A	j	Lowercase J
92	k	Lowercase K	6B	k	Lowercase K
93	l	Lowercase L	6C	l	Lowercase L
94	m	Lowercase M	6D	m	Lowercase M
95	n	Lowercase N	6E	n	Lowercase N
96	o	Lowercase O	6F	o	Lowercase O
97	p	Lowercase P	70	p	Lowercase P
98	q	Lowercase Q	71	q	Lowercase Q
99	r	Lowercase R	72	r	Lowercase R
9B*	}	Closing Brace	7D	}	Closing Brace
A1	~	Tilde	7E	~	Tilde
A2	s	Lowercase S	73	s	Lowercase S
A3	t	Lowercase T	74	t	Lowercase T
A4	u	Lowercase U	75	u	Lowercase U
A5	v	Lowercase V	76	v	Lowercase V
A6	w	Lowercase W	77	w	Lowercase W
A7	x	Lowercase X	78	x	Lowercase X
A8	y	Lowercase Y	79	y	Lowercase Y
A9	z	Lowercase Z	7A	z	Lowercase Z
AD	[	Opening Bracket	5B	[	Opening Bracket
BD	]	Closing Bracket	5D	]	Closing Bracket
C0	{	Opening Brace	7B	{	Opening Brace
C1	A	Uppercase A	41	A	Uppercase A
C2	B	Uppercase B	42	B	Uppercase B
C3	C	Uppercase C	43	C	Uppercase C
C4	D	Uppercase D	44	D	Uppercase D
C5	E	Uppercase E	45	E	Uppercase E
C6	F	Uppercase F	46	F	Uppercase F
C7	G	Uppercase G	47	G	Uppercase G
C8	H	Uppercase H	48	H	Uppercase H
C9	I	Uppercase I	49	I	Uppercase I
D0	}	Closing Brace	7D	}	Closing Brace
D1	J	Uppercase J	4A	J	Uppercase J
D2	K	Uppercase K	4B	K	Uppercase K
D3	L	Uppercase L	4C	L	Uppercase L
D4	M	Uppercase M	4D	M	Uppercase M
D5	N	Uppercase N	4E	N	Uppercase N
D6	O	Uppercase O	4F	O	Uppercase O
D7	P	Uppercase P	50	P	Uppercase P
D8	Q	Uppercase Q	51	Q	Uppercase Q
D9	R	Uppercase R	52	R	Uppercase R
E0	\	Reverse Slant	5C	\	Reverse Slant
E2	S	Uppercase S	53	S	Uppercase S
E3	T	Uppercase T	54	T	Uppercase T
E4	U	Uppercase U	55	U	Uppercase U
E5	V	Uppercase V	56	V	Uppercase V
E6	W	Uppercase W	57	W	Uppercase W
E7	X	Uppercase X	58	X	Uppercase X
E8	Y	Uppercase Y	59	Y	Uppercase Y
E9	Z	Uppercase Z	5A	Z	Uppercase Z
F0	0	Zero	30	0	Zero
F1	1	One	31	1	One
F2	2	Two	32	2	Two
F3	3	Three	33	3	Three
F4	4	Four	34	4	Four
F5	5	Five	35	5	Five
F6	6	Six	36	6	Six
F7	7	Seven	37	7	Seven
F8	8	Eight	38	8	Eight
F9	9	Nine	39	9	Nine

*8B and 9B left for compatibility with old ANL standard.

Table 14

ANL Character Translation Tables: ASCII to EBCDIC

ASCII HEX	CHAR	NAME	EBCDIC HEX	CHAR	NAME
00	NUL	Null	00	NUL	Null
01	SOH	Start of Heading	01	SOH	Start of Heading
02	STX	Start of Text	02	STX	Start of Text
03	ETX	End of Text	03	ETX	End of Text
04	EOT	End of Transmission	37	EOT	End of Transmission
05	ENQ	Enquiry	2D	ENQ	Enquiry
06	ACK	Acknowledge	2E	ACK	Acknowledge
07	BEL	Bell	2F	BEL	Bell
08	BS	Backspace	16	BS	Backspace
09	HT	Horizontal Tabulation	05	HT	Horizontal Tab
0A	LF	Line Feed	25	LF	Line Feed
0B	VT	Vertical Tabulation	0B	VT	Vertical Tab
0C	FF	Form Feed	0C	FF	Form Feed
0D	CR	Carriage Return	0D	CR	Carriage Return
0E	SO	Shift Out	0E	SO	Shift Out
0F	SI	Shift In	0F	SI	Shift In
10	DLE	Data Link Escape	10	DLE	Data Link Escape
11	DC1	Device Control 1	11	DC1	Device Control 1
12	DC2	Device Control 2	12	DC2	Device Control 2
13	DC3	Device Control 3	13	TM	Tape Mark
14	DC4	Device Control 4	14	DC4	Device Control 4
15	NAK	Negative Acknolwedge	3D	NAK	Negative Acknowledge
16	SYN	Synchronous Idle	32	SYN	Synchronous Idle
17	ETB	End of Trans. Block	26	ETB	End of Trans. Block
18	CAN	Cancel	18	CAN	Cancel
19	EM	End of Medium	19	EM	End of Medium
1A	SUB	Substitute	27	ESC	Escape
1C	FS	File Separator	1C	IFS	Interchange File Sep.
1D	GS	Group Separator	1D	IGS	Interchange Group Sep.
1E	RS	Record Separator	1E	IRS	Interchange Record Sep.
1F	US	Unit Separator	1F	IUS	Interchange Unit Sep.
20	SP	Space	40	SP	Space
21	!	Exclamation Point	5A	!	Exclamation Point
22	"	Quotation Marks	7F	"	Quotation Mark
23	#	Number Sign	7B	#	Number Sign
24	$	Dollar Sign	5B	$	Dollar Sign
25	%	Percent	6C	%	Percent
26	&	Ampersand	50	&	Ampersand
27	'	Prime, Apostrophe	7D	'	Prime, Apostrophe
28	(	Opening Parenthesis	4D	(	Left Parenthesis
29	)	Closing Parenthesis	5D	)	Right Parenthesis
2A	*	Asterisk	5C	*	Asterisk
2B	+	Plus	4E	+	Plus
2C	,	Comma	6B	,	Comma
2D	-	Minus Sign, Hyphen	60	-	Minus Sign, Hyphen
2E	.	Period, Decimal Point	4B	.	Period, Decimal Point
2F	/	Slant	61	/	Slash
30	0	Zero	F0	0	Zero
31	1	One	F1	1	One
32	2	Two	F2	2	Two
33	3	Three	F3	3	Three
34	4	Four	F4	4	Four
35	5	Five	F5	5	Five
36	6	Six	F6	6	Six
37	7	Seven	F7	7	Seven
38	8	Eight	F8	8	Eight
39	9	Nine	F9	9	Nine
3A	:	Colon	7A	:	Colon
3B	;	Semicolon	5E	;	Semicolon
3C	<	Less-than Sign	4C	<	Less-than Sign
3D	=	Equals	7E	=	Equal Sign
3E	>	Greater-than Sign	6E	>	Greater-than Sign
3F	?	Question mark	6F	?	Question Mark
40	@	Commercial At	7C	@	At Sign

ASCII HEX	CHAR	NAME	EBCDIC HEX	CHAR	NAME
41	A	Uppercase A	C1	A	Uppercase A
42	B	Uppercase B	C2	B	Uppercase B
43	C	Uppercase C	C3	C	Uppercase C
44	D	Uppercase D	C4	D	Uppercase D
45	E	Uppercase E	C5	E	Uppercase E
46	F	Uppercase F	C6	F	Uppercase F
47	G	Uppercase G	C7	G	Uppercase G
48	H	Uppercase H	C8	H	Uppercase H
49	I	Uppercase I	C9	I	Uppercase I
4A	J	Uppercase J	D1	J	Uppercase J
4B	K	Uppercase K	D2	K	Uppercase K
4C	L	Uppercase L	D3	L	Uppercase L
4D	M	Uppercase M	D4	M	Uppercase M
4E	N	Uppercase N	D5	N	Uppercase N
4F	O	Uppercase O	D6	O	Uppercase O
50	P	Uppercase P	D7	P	Uppercase P
51	Q	Uppercase Q	D8	Q	Uppercase Q
52	R	Uppercase R	D9	R	Uppercase R
53	S	Uppercase S	E2	S	Uppercase S
54	T	Uppercase T	E3	T	Uppercase T
55	U	Uppercase U	E4	U	Uppercase U
56	V	Uppercase V	E5	V	Uppercase V
57	W	Uppercase W	E6	W	Uppercase W
58	X	Uppercase X	E7	X	Uppercase X
59	Y	Uppercase Y	E8	Y	Uppercase Y
5A	Z	Uppercase Z	E9	Z	Uppercase Z
5B	[	Opening Bracket	AD	[	Opening Bracket
5C	\	Reverse Slant	E0	\	Reverse Slant
5D	]	Closing Bracket	BD	]	Closing Bracket
5E	^	Circumflex	5F	¬	Logical Not
5F	_	Underline	6D	_	Underscore
60	`	Grave Accent	79	`	Grave Accent
61	a	Lowercase A	81	a	Lowercase A
62	b	Lowercase B	82	b	Lowercase B
63	c	Lowercase C	83	c	Lowercase C
64	d	Lowercase D	84	d	Lowercase D
65	e	Lowercase E	85	e	Lowercase E
66	f	Lowercase F	86	f	Lowercase F
67	g	Lowercase G	87	g	Lowercase G
68	h	Lowercase H	88	h	Lowercase H
69	i	Lowercase I	89	i	Lowercase I
6A	j	Lowercase J	91	j	Lowercase J
6B	k	Lowercase K	92	k	Lowercase K
6C	l	Lowercase L	93	l	Lowercase L
6D	m	Lowercase M	94	m	Lowercase M
6E	n	Lowercase N	95	n	Lowercase N
6F	o	Lowercase o	96	o	Lowercase O
70	p	Lowercase P	97	p	Lowercase P
71	q	Lowercase Q	98	q	Lowercase Q
72	r	Lowercase R	99	r	Lowercase R
73	s	Lowercase S	A2	s	Lowercase S
74	t	Lowercase T	A3	t	Lowercase T
75	u	Lowercase U	A4	u	Lowercase U
76	v	Lowercase V	A5	v	Lowercase V
77	w	Lowercase W	A6	w	Lowercase W
78	x	Lowercase X	A7	x	Lowercase X
79	y	Lowercase Y	A8	y	Lowercase Y
7A	z	Lowercase Z	A9	z	Lowercase Z
7B	{	Opening Brace	C0	{	Opening Brace
7C	|	Vertical Line	4F	|	Logical OR
7D	}	Closing Brace	D0	}	Closing Brace
7E	~	Tilde	A1	~	Tilde
7F	Del	Delete	07	Del	Delete

APPENDIX D

ANL COMPUTER PROTECTION POLICY

I. PURPOSE

This policy exists to provide guidance for the protection of Laboratory unclassified computer systems and computerized information.

II. SCOPE

This policy covers all unclassified computer systems, including (1) personal computers and word processing systems, (2) computer systems used for scientific and engineering computations, information processing, and experimental control, (3) new, experimental computing systems, and (4) the central computing systems operated by the Computing and Telecommunications Division.

III. POLICY

It is Laboratory policy to protect its computers, the information stored in them, and the sensitive applications running on them. They are to be protected, as far as is reasonably possible, from unauthorized access to applications and computing resources, and unauthorized (or accidental) modification (or destruction) of information. Adequate protection will be based on an evaluation of risks, a cost/benefit analysis of protection measures, and the sensitivity and value of the assets to be protected. It is Laboratory policy that the primary responsibility for protection of Laboratory computers, programs, and data lie directly with the users, operators, and managers of those Laboratory assets. It is Laboratory policy that all users, operators, and managers of computing resources be trained in their computer protection responsibilities. It is Laboratory policy that Laboratory-owned computers be used only for Laboratory-approved work.

IV. GOALS

A. To protect sensitive computer applications (e.g., accounts payable, personnel, and sensitive DOE energy programs) from unauthorized alteration or disclosure.

B. To protect computer systems from deliberate or accidental physical damage.

C. To protect computer data and applications from deliberate or accidental modification or destruction.

D. To provide adequate and realistic backup procedures and contingency plans that will protect the Laboratory from the consequences of any serious computer failures, and to provide for continuity of operations for computer applications supporting DOE mission-essential functions.

E. To prevent the use of Laboratory computers for unauthorized purposes.

F. To follow DOE requirements for reporting computer security incidents.

V. RESPONSIBILITIES

A. The Computing Policy Committee:

1. Advises the Laboratory Chief Operations Officer on the suitability of proposed Computer Protection Policies.

2. Approves plans for implementing proposed policies.

B. The Director of Computing and Telecommunications appoints the ANL Computer Protection Program Manager.

C. The Site Manager of Argonne West appoints the Associate Computer Protection Program Manager for Argonne West.

D. ANL Division Directors, Program Managers, and Department Heads:

1. Appoint a Divisional, Program, or Departmental Computer Protection Program Representative for their organization.

2. Appoint an Assistant Computer Protection Program Manager for each sensitive computer in their organization (one person may be responsible for more than one system). This person is usually (but need not be) the system manager for the computer.

3. Insure that computer security awareness and education training is provided for their organizations.

E. The Computer Protection Program Manager:

1. Formulates ANL computer protection policies.

2. Prepares the Laboratory's Computer Protection Plan.

3. Manages a program to identify sensitive computer applications.

4. Manages a program to review, test, and approve protection plans for sensitive applications and computer systems.

5. Reviews and approves the computer protection aspects of audit inspections.

6. Conducts appraisals of adherence to the Laboratory's Computer Protection Plan.

7. Manages a computer security education and awareness program.

8. Manages a program to train divisional Computer Protection Program Representatives and Assistant Computer Protection Program Managers.

9. Manages the Laboratory's computer-incident reporting system.

10. Maintains the Laboratory's computer protection files.

11. Coordinates requirements for the unclassified computer protection program with Laboratory personnel having responsibilities for telecommunications security and classified computer security.

12. Serves as a Laboratory focal point to coordinate with DOE on matters involving unclassified computer security.

F. The Associate Computer Protection Program Manager for Argonne West:

1. Coordinates computer protection activities at Argonne West to comply with the ANL Computer Protection Program.

2. Formulates computer protection policies for Argonne West (in cooperation with the Computer Protection Program Manager).

3. Reviews and approves the computer protection aspects of audit inspections at Argonne West.

4. Reviews protection plans and conducts appraisals of adherence to the Laboratory's Computer Protection Plan at Argonne West.

5. Coordinates the computer security education and awareness training at Argonne West.

6. Coordinates Argonne West's computer-incident reporting and subsequent investigations for incidents at Argonne West.

G. The Computer Protection Program Representatives:

1. Charge the manager of each new or significantly changed application to determine the sensitivity of the application and forward that information to the Computer Protection Program Manager.

2. Review, approve, and have available upon request risk assessments and protection plans for sensitive applications and computer systems in their organizations.

3. Ensure compliance with generic Laboratory risk assessments and protection plans (or write an individual risk assessment and protection plan) for non-sensitive computer applications and systems in their organizations.

4. Conduct security-design reviews and tests, and certify and re-certify protection measures for sensitive computers and applications in their organizations.

5. Ensure that personnel in their organizations receive computer security education and awareness training.

6. Report and document computer security incidents in their organizations in compliance with the ANL computer incident reporting procedures.

7. Review the contents of unclassified divisional computer systems at unannounced intervals with the knowledge and cooperation of division management by random sampling. Document the results, and forward any findings to the Computer Protection Program Manager. This review must occur at least annually, but may not cover every computer. The resources used should be commensurate with the loss expectancy.

H. The Director of Management Information Systems:

1. Appoints a Computer Protection Program Representative for systems maintained by Management Information Systems.

2. Reviews risk assessments and protection plans for all Laboratory-wide sensitive information-system applications.

I. The Computer Protection Program Representative for Management Information Systems:

1. Charges the manager of each new or significantly changed application managed by Management Information Systems to determine the sensitivity of the application and forwards that information to the Computer Protection Program Manager.

2. Reviews, approves, and has available upon request risk assessments and protection plans for sensitive applications maintained by Management Information Systems.

3. Insures compliance with generic Laboratory risk assessments and protection plans, (or writes individual risk assessments and protection plans) for non-sensitive computer applications and systems maintained by Management Information Systems.

4. Conducts security-design reviews and tests, certifies, and re-certifies security specifications for sensitive applications.

5. Insures that personnel in Management Information Systems receive computer security and awareness training commensurate with their responsibilities.

6. Manages the documentation and reporting of computer security incidents involving applications maintained by Management Information Systems.

7. Reviews and approves the computer protection aspects of audit inspections made on systems maintained by Management Information Systems.

J. The Assistant Computer Protection Program Managers:

1. Prepare and have available on request risk assessments and Computer Protection Plans for each of the sensitive computers for which they are responsible. This task can be delegated to the system manager for the computer system and then approved by the assistant, where the two are not the same person.

2. Submit the protection checklist for their computer(s) to the Computer Protection Program Manager.

K. The Managers of Computer Applications:

1. Complete a Computer Application Sensitivity Questionnaire for each new or significantly changed application and verify the information as requested by the Computer Protection Program Manager.

2. Insure that adequate back-up protection exists for the application data.

3. Comply with protection measures documented in the protection plan.

L. The Managers of Sensitive Computer Applications:

1. Prepare risk assessments and protection plans (and, where appropriate, contingency plans) for each sensitive computer application.

2. Insure that the protection of any computer system on which the application runs is adequate for the protection needs of the application.

M. The System Managers of Non-Sensitive Computer Systems insure that the computer system complies with Laboratory policy and procedures for the protection of computing resources.

N. The Requisitioners of Sensitive Computer Applications or Significant Computer Systems:

1. Include appropriate protection requirements in the procurement specifications.

2. Provide completed sensitive computer system or application checklists.

O. The Procurement Department ensures that procurement requests for sensitive computer systems and computer applications are in compliance with ANL procurement procedures.

P. The Human Resources Department performs normal pre-employment screening checks on prospective employees.

Q. The Internal Audit Department reviews the contents of the ANL mainframe computer systems at unannounced intervals by random sampling at the request of the Computer Protection Program Manager, and subject to effort constraints.

R. The Computer Users:

1. Provide adequate protection, including proper password selection and protection and data backup, for the applications, data, and computers they use.

2. Report computer-security incidents and other suspicious happenings or activities to the proper authority.

3. Understand and comply with the *ANL Computer Protection Policy* and computer protection plans for the applications and computer systems they use.

VI. DEFINITIONS

A. An application is a set of all computer programs and related data used in an activity or project or closely related set of activities or projects. Examples of individual applications are the Laboratory's Integrated Financial System, the codes used to calculate the energetics and dynamics of molecular systems, and the codes used to determine core neutronics.

B. A sensitive computer application is an application that requires protection because it contains data that must legally be protected (e.g., Privacy Act Information, Unclassified, Controlled Nuclear Information, Official Use Only Information) or because of the risk and magnitude of loss or harm that could result from improper operation or deliberate manipulation of the application (e.g., payroll, personnel, proprietary code, DOE energy code, reactor control code, and substantial financial loss).

C. A sensitive computer system is a computer system that processes sensitive applications or one that qualifies as sensitive because it is significant (see below).

D. A significant computer system is a computer system that consists of a stand-alone computer with peripheral equipment or a network of computer systems. The capacity of the system or network is such that its computing capacity currently requires it to be reported in the annual DOE Information Technology Resources long range planning process.

E. A protection checklist is either of two specific forms. The "Sensitive Application Checklist" describes the information needed to complete a protection plan for a sensitive application. The "Sensitive Computer System Checklist" describes the information needed to complete a protection plan for a sensitive computer system.

Wednesday, June 28, 1989

APPENDIX E

ANL PROCEDURE FOR REPORTING COMPUTER SECURITY INCIDENTS

Requirements

DOE Order 1360.2A describes significant computer security incidents and requires that they be documented and reported to DOE. This document defines the ANL procedures to be followed in reporting all unclassified computer security incidents. Table 15 classifies security incidents according to their severity, by using the description of significant from DOE Order 1360.2A, and defines the final reporting authority for each classification of incident.

Responsibility for Administering the ANL Computer Protection Policy

The primary responsibility for protecting Laboratory sensitive applications and the computers on which they run rests with those persons who operate the computers and who design, maintain, and use the applications. The Argonne Computer Protection Program Manager is responsible for administering a program to assure the adequacy of and compliance with standards for the protection of unclassified computer systems and applications at Argonne National Laboratory. The Director or Manager of every division, department, or program within ANL appoints a Computer Protection Program Representative who is responsible for ensuring protection policy compliance for the sensitive and critical applications and computers belonging to that division, department, or program. Assistant Computer Protection Program Managers are appointed by division directors and program or department managers for every computer system whose capacity and value require it to be reported in the *ANL Site Response for the DOE Information Technology Resources Long-Range Plan.* These Assistants are responsible for the security of those computers and the data and applications residing on them.

Initial Reporting of Incidents

A person who believes a computer security incident has occurred on one of the Laboratory's central computers operated by the Computing and Telecommunications Division should report the incident directly to the Laboratory's Computer Protection Program Manager, who will verify and determine the severity of the incident and will follow these documentation, investigation, and reporting procedures. The Computer Protection Program Manager must report all security incidents involving an ANL employee to the director or manager of the ANL program, department, or division for whom the employee works.

A person who believes a computer security incident involving a distributed divisional computer or workstation has occurred should immediately report the incident to the Assistant Computer Protection Program Manager responsible for the computer on which the incident occurred or to the Computer Protection Program Representative for the ANL organization involved. The Assistant or Representative will report all incidents to the responsible line manager. The Assistant or the Representative shall make a preliminary determination of the severity of the incident and shall immediately report incidents of severity level 2 or higher to the Computer Protection Program Manager. The Computer Protection Program Manager will make the final determination of the sensitivity of incidents of severity level 2 or higher and will follow these documentation, investigation, and reporting procedures.

Subsequent Reporting

The ANL Computer Protection Program Manager will promptly report incidents of level 2 and higher to the Chief Operations Officer; and they, together with the Manager of the ANL Security Department, will make the final determination of the severity of those incidents and determine what type of future action (e.g., legal counsel, law enforcement) is required. Severity level 3 incidents are significant, as described in "DOE

Order 1360.2A," and will be reported by the Computer Protection Program Manager to DOE by using the reporting procedures outlined in the DOE "Computer Security Incident Reporting Procedures."

Investigation and Documention of Incidents

The responsible Assistant Computer Protection Program Manager or the Computer Protection Program Representative will investigate level 2 or 3 incidents occurring in the Assistant's or Representative's jurisdiction under the direction of the Computer Protection Program Manager. The Assistant or Representative will prepare a preliminary report to be delivered to the ANL Computer Protection Program Manager within two working days of the incident. When the investigation is complete, the Assistant or Representative will send a final report to the ANL Computer Protection Program Manager to keep as a part of the Laboratory computer protection records.

The ANL Computer Protection Program Manager will investigate incidents occurring on the central computers or applications that are processed on the central computers, and will keep on file the final reports of all computer security incidents of severity level 2 and higher for a period of at least three years.

Alternate Reporting Points

In cases where the Assistant Computer Protection Program Manager or the Computer Protection Program Representative cannot be located, the person reporting the incident will contact the ANL Computer Protection Program Manager directly.

In cases where the ANL Computer Protection Program Manager cannot be located, the Associate Director for Operations in the Computing and Telecommunications Division shall be notified.

In cases where neither the ANL Computer Protection Program Manager nor the Associate Director for Operations in the Computing and Telecommunications Division can be located, the Director of the Computing and Telecommunications Division shall be notified.

Appropriate Personnel and Their ANL Telephone Numbers

ANL Computer Protection Program Manager (L. Jean Troyer)	2-7440
CTD Associate Director for Operations (L. Michael Boxberger)	2-5638
Director of Computing and Telecommunications (David Weber)	2-7155
ANL Chief Operations Officer (Ronald Teunis)	2-5569

Table 15
Computer Security Incident Classifications

Level	Type of Incident and Reporting Authority
1. Minor	Unauthorized sharing of user verification passwords; attempts to access a system with little chance of success; inadvertent access to sensitive information; minor abuse of a system by authorized users (e.g., games and recreation). Must be reported to the Assistant Computer Protection Program Manager for the system and to the Director or Manager of the ANL program, department, or division.

Incidents on the Laboratory's central computers must be reported to the Computer Protection Program Manager. |
| 2. Important | Major misuse or abuse of a system by an authorized user (e.g., using the system to support a personal business); penetration of system by unauthorized, non-ANL persons; deliberate access to or distribution of sensitive information; concentrated attempts to gain access to an ANL Computer System. Must be reported to the Computer Protection Program Manager and to the ANL Chief Operations Officer. |
| 3. Significant | Deliberate destruction or unauthorized modification of sensitive or mission-critical data, or any incident that may result in loss, harm, or embarrassment to DOE; criminal actions which may be prosecuted in the courts; incidents whose reporting could benefit other DOE installations susceptible to the same threats (e.g., security holes in major operating systems). Must be reported to DOE according to DOE-CH requirements. |

January 1989

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