MWS-E User Guide

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Record of Revision

Each time this manual is updated with a change packet, a change to part of a text page is indicated by a change bar in the margin directly opposite the change. A change bar in the footer of a text page indicates that most, if not all, of the text is new. A change bar in the footer of a page composed primarily of a table and/or figure may indicate that a change was made to that table/figure or, it could indicate that the entire table/figure is new. Change packets are assigned a numerical designator, which is indicated in the publication number on each page of the change packet.

Each time this manual is fully revised and reprinted, all change packets to the previous version are incorporated into the new version, and the new version is assigned an alphabetical revision level, which is indicated in the publication number on each page of the manual. A revised manual does not usually contain change bars.

REVISION	DESCRIPTION
	June 1991. Original printing.
A	January 1992. Reprint with revision. This manual is revised to reflect technical changes related to the ME1.1 diagnostic release. The “Error Logging System,” “Installing and Using AnswerBook,” and “System Clear Utility” sections are new. Many other technical changes and additions are incorporated.
A1	February 1992. Change packet including minor technical changes in Section 9, the addition of an Index, and an updated Table of Contents.
B	March 1993. Reprint with revision. This user guide is revised to reflect technical changes related to the ME-Y2.0 and ME-C1.0 diagnostic releases and SunOS 4.1.2. The “EASE Error Logger,” and “New WACS User Information” sections are new. Many other technical changes and additions are incorporated.
B1	April 1994. Change packet adds a procedure in Section 4 for using the system utility, viewcd.
B2	March 1998. Change packet removes references to the `haltos` command and removes the procedures that enable and disable the temporary use of the MWS-E to function as an OWS-E. Change packet also removes Sections 7, 8, and 11, which are now obsolete.

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4 MAINTENANCE & DIAGNOSTIC ENVIRONMENT

5 SYSTEM ADMINISTRATION

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7 WACS USER INFORMATION

This section has been removed.

8 EASE ERROR LOGGER

This section has been removed.

9 INSTALLING AND USING ANSWERBOOK

10 SYSTEM CLEAR UTILITY

11 NEW WACS USER INFORMATION

This section has been removed.

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FIGURES

FIGURES (continued)

TABLES

1 USER GUIDE OVERVIEW

The *MWS-E User Guide* is designed as a guide to understanding the basic principles and most frequently used procedures needed for typical day-to-day operations of the maintenance workstation model E (MWS-E). An overview of both the MWS-E and the operator workstation model E (OWS-E) is presented in the *MWS-E and OWS-E Hardware Maintenance Manual*, publication number CMM-1122-0B0; workstation overview information is not duplicated in this guide.

The hardware maintenance manual and this user guide are a documentation set; their contents are divided by the primary functions they support. The hardware maintenance manual provides maintenance, diagnostic testing, troubleshooting, and parts information for both the MWS-E and OWS-E systems. This user guide provides information used to operate, administrate, and secure the MWS-E. The procedures and how-to examples in this guide use the generic name ‘‘mws1234’’ to represent all MWS-E systems. A general overview of all diagnostic software stored on the MWS-E and used to maintain Cray Research, Inc. (CRI) computer systems is described in Section 4 of this guide.

Screen output is indicated by `Courier` type. Commands that the user should enter appear in **`Courier bold`** type.

Detailed information on the Sun operating system is covered in the Sun Microsystems, Inc. documentation supplied with the MWS-E system; refer to ‘‘Documentation’’ at the end of Section 1 in the *MWS-E and OWS-E Hardware Maintenance Manual* for a complete list of all Sun documents.

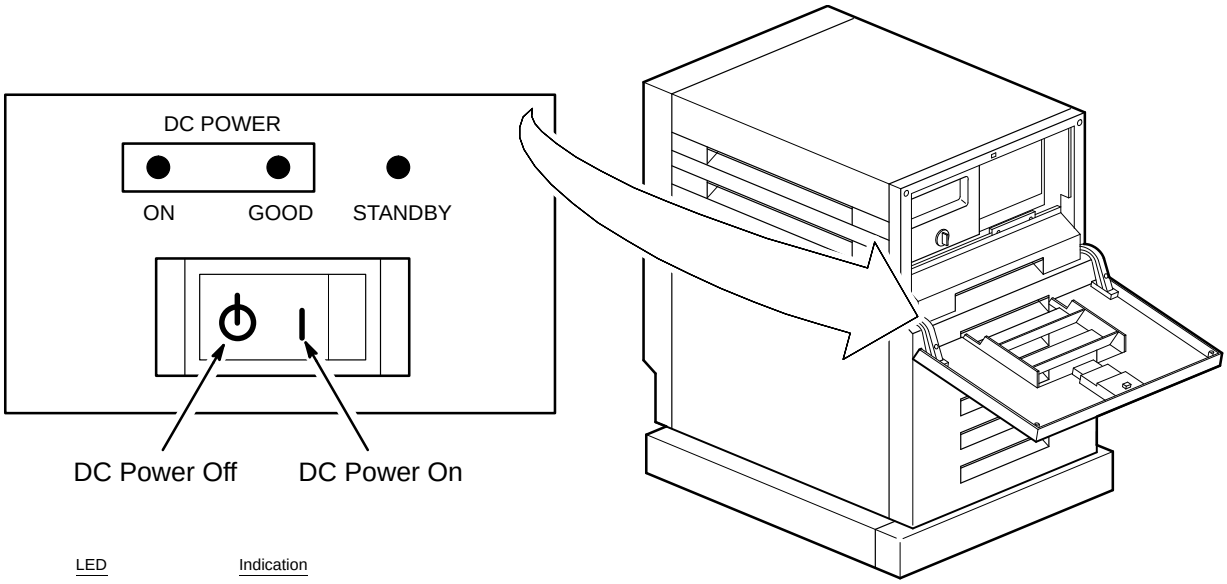
To relay any suggestions, comments, or criticisms on the hardware maintenance manual or this user guide to the Hardware Publications and Training department at Customer Service in Chippewa Falls, use the reader comment forms included at the front and back of both manuals.

NOTE: Please send any suggestions, comments, or criticisms on the hardware maintenance manual or this user guide to the Hardware Publications and Training (HPT) department at Customer Service in Chippewa Falls. You can either use one of the reader comment forms included at the front and back of both manuals or you can send E-mail to `HPT@techops`. When sending E-mail, please be as specific as possible when describing the problem or suggestion; also don’t forget to include the publication number.

2 SYSTEM STARTUP AND SHUTDOWN

Powering up the maintenance workstation model E (MWS-E) and preparing it to operate involves booting the operating system (loading the software from the hard disk into the computer's memory).

The MWS-E graphics display console is used to start up and shut down the UNIX based Sun operating system. The DC power switch on the workstation is located under the front cover, at the top left of the chassis (refer to Figure 2-1). The front cover is held in place by a latch that is accessed through the front of the top slot.



LED	Indication
ON	DC Power is Connected
GOOD	Voltage Level is Good
STANDBY	DC Power Switch is in the Off Position

A-10404

Figure 2-1. Power Switch Location

MWS-E Startup Procedure

The following procedure describes how to perform a normal system startup and how to log on as the **mws** user. (Refer to ‘‘System Startup and Shutdown Commands’’ on page 2-11 for a list of startup and shutdown commands.)

1. Set the DIAG/NORM switch on the back of the CPU to the NORM position.

2. Set the power switch on the color graphics display to the On (|) position. (The green LED on the display should illuminate.)

3. Set the DC power switch to the On position (refer to Figure 2-1).

The four green LEDs on the keyboard flash and the keyboard beeps. You should hear the fans on the workstation chassis start up. The display screen illuminates in a few seconds and displays the following message:

```
Selftest Completed.

        Sun SPARCsystem 300.
        Type–4 keyboard
        ROM Rev 3.0.3, 16MB memory installed, Serial #______
         Ethernet address  :_:__:_:__:__: Host ID 2300____

Testing 16 Megabytes of Memory /
```

The memory test takes 1 to 2 minutes to test. After the memory test is complete, a number of messages scroll by on the display screen while the operating system is booting. The following messages are displayed:

```
Auto–boot in progress...
Boot: sd (0,0,0)
root on sd0a fstype 4.2
Boot: vmunix
Size: 1122304+.......+.......+.......
   .
   .
```

The boot process continues as the system polls for devices found in the operating system kernel. The poll process reads a parameter in the boot PROM to determine from which device to boot `vmunix` (the operating system kernel file). The `sd0a` partition is the root file system on the SCSI hard disk.

The following screen display shows some of the device messages that appear (refer to ‘‘Device Drivers’’ on page 2-10 for a definition of the device drivers):

```
SunOS Release 4.1.2 (FEI3) #1: Thu Jan 21 10:44:27 CST 1993
Copyright (c) 1983–1990, Sun Microsystems, Inc.
cpu = Sun SPARCsystem 300
mem = 16384K (0x1000000)
avail mem = 14942208
Ethernet address = 8:0:20:8:ef:4d
sm0 at obio 0xfa000000 pri 2
st0 at sm0 slave 32
sr0 at sm0 slave 48
sd0 at sm0 slave 0
sd1 at sm0 slave 1
zs0 at obio 0xf1000000 pri 3 <
zs1 at obio 0xf0000000 pri 3
zs2 at obio 0xe0000000 pri 3
le0 at obio 0xf9000000 pri 3
cgsix0 at obio 0xfb000000 pri 4
fy0 at vme16d32 0xe000 vec 0xcdvec
fy1 at vme16d32 0xe200 vec 0xcdvec
cv0 at vme16d16 0xe000 vec 0xc8
cv1 at vme16d16 0xe000 vec 0xcc
cv2 at vme16d16 0xe000 vec 0xd0
cv3 at vme16d16 0xe000 vec 0xd4
elb0 at vme16d16 0x5800 vec 0xd8
```

Device Drivers

The file system check (`fsck`) utility ensures file system integrity and attempts to repair any inconsistencies. If errors are encountered, the `fsck` utility attempts to correct them and reboots the system.

```
Checking filesystems
   .
   .
   .
```

After file systems are checked, the automatic `reboot` process begins:

```
Automatic reboot in progress...
   .
   .
   .
```

The date and a `login` prompt are displayed after the system successfully completes the `boot` process:

```
Mon Apr 12 16:19:24 CST 1993
mws1234 login:
```

4. Log on to the MWS-E by typing the **`mws`** login and password.

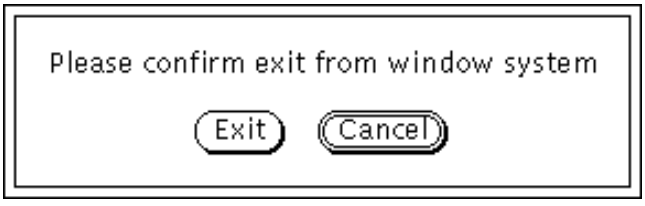
The screen clears and a Cray Research banner is displayed on the screen. A standardized five-window environment is initialized and displayed. Refer to Section 3, ‘‘User Environment,’’ for more information.

MWS-E Shutdown Procedure

The following procedure describes how to perform a normal system shutdown starting from the standard mws window environment. You can not use this procedure if your MWS-E is set to disallow a `root` login from the console. In this situation, enter the **`su`** command from an `xterm` window to gain super-user privileges. Then use the **`shutdown -h now`** command to move the system to monitor mode. You will receive two `xinit` error messages, which are normal in this situation.

1. Move the cursor to the CRI background screen (the base window that covers the entire screen is called the *root window* or *workspace*).
2. Push down the right mouse (menu) button and select *exit* from the workspace menu that appears.

The following menu appears in the middle of the screen:



3. Select the exit button with the left mouse button.

   Selecting the exit button automatically logs the `mws` login off the system. Then the screen clears and a login prompt appears.

4. Log on as `root` and check to see if any other users are on the system, as shown in the following screen display:

```
mws1234 login: root
Password:


mws1234# who
root      console     <date + time displayed here>
```

5. Enter one of the following commands depending on whether any other users are logged on to the system:

   Use the **now** option when root is the only user on the MWS-E system; use the **+5** option when other users are logged on the MWS-E system to warn them that the system is going down in 5 minutes.

```
mws1234# shutdown –h now

mws1234# shutdown –h +5
```

   The system displays warning messages to all users that the system is coming down either immediately (if you used the **now** parameter) or in 5 minutes. A message similar to the following screen display then appears:

```
*** FINAL System shutdown message from root@mws1234 ***

System is going down IMMEDIATELY

System shutdown time has arrived
Jun 1  14:49:53 mws1234 shutdown:halt by root
Jun 1   14:59:54 mws1234 syslogd: going down on signal
15
syncing file systems ... done
Halted

>
```

The monitor mode prompt (>) is displayed after you use the **`shutdown -h`** command.

The workstation DC power switch and graphics tube may be turned off when the monitor prompt is displayed; *do not* turn off the power switch when the system is in single-user or multi-user modes. From the monitor mode prompt, you can use the **`k2`** power-on reset command or the **`b`** default `boot` command to return the system to multi-user mode.

Startup Process

The startup process, from turning on the power switch until the login prompt appears, is explained in the following paragraphs. Names of major processes and files appear in **bold** text.

Power on – The startup process begins when the DC power switch is toggled to the ON position (the power supply AC switch must be on). Immediately after you toggle on the power switch, instructions are fetched from the boot PROM and all eight LEDs on the back of the CPU illuminate.

Self-tests – Next, a series of diagnostic self-tests start running. As the self-tests run, the LEDs on the CPU board are illuminated in a pattern that indicates the test that is running.

If a test fails, LED 7 illuminates and LEDs 0 through 4 illuminate in a binary pattern to indicate the test that failed. The failed self-test continues to re-execute until the space bar is pressed to continue the self-test sequence. Refer to Figure 2-2 and Table 2-1 for descriptions of failed self-tests and their corresponding LED patterns.

During startup, the monitor program in the CPU's boot PROM controls operation of the system until the operating system kernel takes control. The boot PROM starts the self-diagnostic routine and locates the parameters it needs from the electrically eraseable programmable read-only memory (EEPROM) chip on the CPU board.

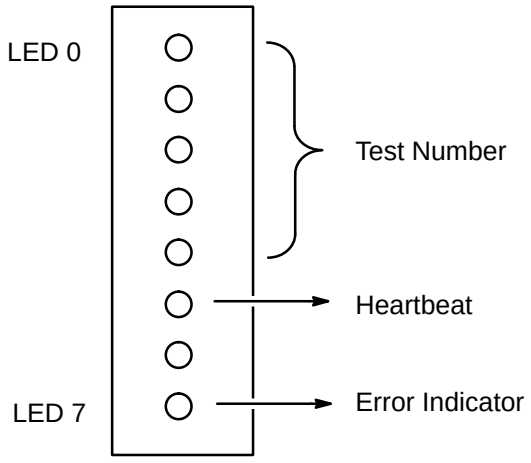


Figure 2-2. CPU LED Self-test Indicators

Table 1. Self-test Error Codes

7							0	Self-test	Failing Component
○	○	○	○	○	○	○	○	LED loop test	Boot PROM, +5 Vdc
○	○	○	○	○	○	○	●	Initialize SCC UART	Serial ports
○	○	○	○	○	○	●	○	“Boot PROM Selftest” message	Serial ports
○	○	○	○	○	○	●	●	EEPROM checksum test	Boot PROM
○	○	○	○	○	●	○	○	Context register read/write test	Boot PROM
○	○	○	○	○	●	○	●	Segment map tests	MMU
○	○	○	○	○	●	●	○	Page map tests	MMU
○	○	○	○	○	●	●	●	Software traps test	MMU
○	○	○	○	●	○	○	○	Interrupt software and register tests	Interrupt register, IU
○	○	○	○	●	○	○	●	Time-of-day interrupt test	Interrupt register, IU
○	○	○	○	●	○	●	○	Video memory tests	TOD clock, battery
○	○	○	○	●	○	●	●	Main memory tests	Video RAM, CPU
○	○	○	○	●	●	○	○	MMU read access/modified bits test	Memory jumpers, CPU
○	○	○	○	●	●	○	●	MMU write access/modified bits test	MMU
○	○	○	○	●	●	●	○	MMU write to write = protected page	MMU
○	○	○	○	●	●	●	●	MMU read not-writeable invalid page	MMU
○	○	○	●	○	○	○	○	MMU read writeable invalid page	MMU
○	○	○	●	○	○	○	●	MMU write not-writeable invalid page	MMU
○	○	○	●	○	○	●	○	MMU write writeable invalid page	MMU
○	○	○	●	○	○	●	●	Main memory time-out test	MMU
○	○	○	●	○	●	○	○	Control space time-out test	CPU
○	○	○	●	○	●	○	●	Range error test	CPU
○	○	○	●	○	●	●	○	Size error test	CPU
○	○	○	●	○	●	●	●	Parity memory test	Memory
○	○	○	●	●	○	○	○	CPU cache tag RAM tests	CPU
○	○	○	●	●	○	○	●	CPU cache data RAM tests	CPU
○	○	○	●	●	○	●	○	CPU cache functional tests	CPU
○	○	○	●	●	○	●	●	VME loop-back tests	CPU
○	○	○	●	●	●	○	○	IOC tag RAM tests	SIMMs
○	○	○	●	●	●	○	●	IOC data RAM tests	SIMMs
○	○	○	●	●	●	●	○	IOC functional tests	SIMMs

The amount of memory tested in normal mode is specified by a value in the EEPROM. This feature is available because of the amount of time it takes to test memory. Because the MWS-E and OWS-E have 16 Mbytes (32 Mbytes on systems with the upgraded 4300 CPU) of memory versus the maximum of 56 Mbytes of memory with a fully populated memory expansion board, it takes a relatively short time to test memory (approximately 1 minute).

A default value in the EEPROM is set to test all 16 Mbytes of memory. If the workstation is booted in diagnostic mode, all of memory is automatically tested. If the diagnostic self-tests complete without failure, the automatic `boot` process begins.

Boot process – The position of the DIAG/NORM switch on the CPU determines which program is booted. If the switch is set to NORM, the Sun operating system is booted. If the switch is set to DIAG, a program specified by the EEPROM is booted (if no program is specified, the monitor program is invoked). The workstations should be set to automatically execute the `/boot` program stored at partition a of drive 0, controller 0 (`sd0a`). Booting from the `sd0a` address is the same as booting from device `sd(0,0,0)`. The EEPROM also specifies the output display device (normally, the color graphics monitor).

The `/boot` program loads `vmunix` (the kernel file stored on the hard disk) into memory in stages. After `vmunix` is loaded into memory, control is passed to the kernel.

NOTE: The Sun operating system generic kernel is replaced by a CRI specific kernel when the model E maintenance (ME-*xx.x*) diagnostic release is installed. This modified kernel is called named `vmunix`; a backup copy of the kernel file is called `vmunix.MWS_FY` or `vmunix.FEI3_C90.1`, depending on your system. During the ME-*xx.x* install, the CRI specific kernel is named vmunix because the /boot program automatically loads the kernel file called vmunix during bootup. The CRI modified kernel improves boot-up speed and saves kernel space by removing unnecessary devices. The modified kernel also includes CRI device drivers.

Kernel – The kernel probes the bus to check that devices specified in the kernel are present. If a device is not present, the kernel ignores that device. Every time the kernel has to check for nonexistent devices, the boot process is delayed. During this checking process, all kernel device names are displayed on the screen.

usr/etc/init – Next the kernel invokes the `usr/etc/init` file (also called the `init` process) to control the last part of the boot process. The `init` file performs a vital role in the boot process; if `init` quits running or is killed, the system automatically reboots itself. The `init` file invokes the `/etc/rc.boot` , `/etc/rc` , and `/etc/rc.local` scripts. These scripts perform functions that place the system in multi-user mode. The `init` file runs in the background until the system is `shutdown`.

/etc/rc.boot – This file defines the workstation name and runs the `fsck` utility to check for file system inconsistencies, which it normally corrects. (If the **`-b`** option is entered from the `boot` program, the `fsck` process is skipped and `/etc/rc.local` is not executed.) The `fsck` utility corrects minor errors it detects and `reboot`s the system. If `fsck` runs without detecting any minor errors, `init` runs the `/etc/rc` file. If `fsck` detects a serious disk problem, the system is brought up in single-user mode and an error message is displayed.

/etc/rc – This file mounts local file systems, starts standard system daemons, clears the `/tmp` directory, starts system accounting, preserves editor files, and initiates other system activities. During these processes, system control is passed to and from the `/etc/rc.local` script. When the `/etc/rc` file finishes running, the system comes up in multi-user mode.

/etc/rc.local – This script is designed to contain commands unique to a site or specific machine. This script starts network daemons and mounts any specified remote file systems before returning control to the `/etc/rc` file.

/etc/ttytab – In multi-user mode, the ttytab file is read by `init`, which uses the `/usr/etc/getty` command to create a process for terminal ports. The `ttytab` file contains terminal initialization data: device directories, getty baud rate parameters, terminal types, and status and flag information.

The remaining processes occur after startup is complete and a user logs on the system.

/usr/etc/getty – This file starts a process for each terminal port (tty line) defined in the `ttytab` file. The getty file then reads the `login` name, invokes the `login` file, and displays the console `login` prompt.

login – When a user logs on the system, the login file updates accounting files, displays the time the user last logged on, and prints the `/etc/motd` message of the day file. The `login` file also initializes the user and group ID numbers and a current working directory. The `login` file creates a command shell to the specifications defined in the `/etc/passwd` file. The `mws login` runs under the Bourne shell.

Login/Logout Recording Files – When a user logs on the system, the login file creates an entry in the `/etc/utmp` file. When the user logs off, the `init` file clears the entry from the `utmp` file. The `init` file also records all user logins and log off in the `/var/adm/wtmp` file.

Device Drivers

MWS-E device driver definitions are listed in Table 2.

Table 2. MWS-E Device Driver Files

Device Driver	Device
sd0	SCSI hard disk drive
sm0	SCSI controller
sr0	SCSI CD-ROM player
st0	SCSI streaming tape drive
zs0	Serial ports A and B
zs1	Mouse and keyboard
zs2	Serial ports C and D
cgsix0	CG6 color graphics board
cv0 up to cv11 or fy*xx_xx*	FEI-3 board sets
elb0	Error logger board

Operating System Modes

There are three operating system modes as described in the following paragraphs. The command line prompt for each mode is shown in Table 3.

Table 3. Operating System Mode Prompts

Prompt	Mode of Operation	Primary Function
mws1234$	Multi-user mode	Normal user operating environment
mws1234#	Multi-user mode, root login	System administration
#	Single-user mode	Software maintenance
>	Monitor mode	Hardware maintenance

Monitor mode. During system power-up, the monitor mode program controls the system before the UNIX kernel (`vmunix`) takes control. Monitor mode and available commands are described further in the ‘‘Monitor Program’’ subsection. UNIX commands are not available while the monitor mode prompt (>) is displayed.

Single-user mode. When the system is in single-user mode, indicated by the pound sign (#), normally only the root (/) and /usr file systems are mounted; no system or networking daemons are running and the terminal variable ($TERM) is not set. Single-user mode enables the user to safely perform system maintenance functions like fixing corrupted files, performing file system maintenance, and making system backup tapes. You can get to single-user mode by entering the **b -s** command from the monitor mode prompt. You can return the system to multi-user mode by pressing the Control and D keys (**CTRL-D**) from the single-user prompt. *Do not* turn off the workstation DC power switch while the system is in single-user mode.

Multi-user mode. This mode of operation allows full system operations and enables several users to be logged on the system.

Startup and Shutdown Commands

The following commands are described briefly for your convenience. Online manual (man) pages are available for each command. All these commands, except the **sync** and **L1-A** commands, are located in the /usr/etc directory and can be used only under root privilege.

fastboot This shell script reboots the system without running the fsck utility to check the file system. This script is often used after reloading software or implementing changes to system files.

fasthalt This shell script performs the same function as halt except that the file systems are not checked by the fsck utility.

halt This command immediately brings the operating system down and returns control to the monitor program. No warning message that the system is going down is given. The shutdown command provides a more graceful means of shutting the system down.

L1-A This command can be used to abort the boot process. *Do not* use this command if the operating system is running. After aborting the boot process, a message containing the address that the CPU is processing when you entered the L1-A command is displayed.

reboot This command performs an automatic reboot of the system by first running the `sync` and `fsck` utilities. The `reboot` command is typically used to reboot the system (while in single-user mode) to bring it back to multi-user mode.

shutdown This command provides an automated shutdown procedure that notifies users that the system is being shut down and then shuts the system down at the specified time to single-user mode. The `shutdown` command can be executed immediately by using the `now` option, or it can be executed in a specified number of minutes by using the `+<number_of_minutes>` option. The `-h` option runs the `halt` command and brings the system down to monitor mode.

sync This command forces all system I/O processes to be completed. This utility is run by the `shutdown` command before it shuts down the system. Use the `sync` command before the `shutdown` command to ensure that all file system activity is completed before the system is `shutdown`.

NOTE: The `fsck` utility checks and repairs the file system when you `boot` the system or after a system crash occurs. The `halt`, `fasthalt`, `reboot`, and `fastboot` commands synchronize the disk before taking their respective actions.

Monitor Program

The monitor program is contained in the boot PROM on the 4300 CPU board and is used to `boot` from an alternate device, reset the system, and run simple monitor test procedures. Essentially, the monitor provides a low-level interface to the workstation hardware. Changes made with monitor mode commands, except those made with the EEPROM **q** command, are valid as long as the system is powered up. These processes are run from the monitor prompt (>).

Starting the Monitor Program

You can bring up the monitor program in one of two ways depending on the following states of the system:

- The workstation is shut down.
- The operating system is running.

Workstation is Shut Down

Use the following procedure to start the monitor program and display the monitor prompt (>).

1. Toggle the DC power switch to the On position. The power-up and self-test sequence begins (the graphics screen is dark).

2. Immediately after memory testing is completed, as shown in the following message, press the **L1** and **A** keys simultaneously (**L1-A**).

```
Selftest Completed.

        Sun SPARCsystem 300.
        Type-4 keyboard
        ROM Rev 3.0.3, 16MB memory installed, Serial #______
         Ethernet address  :_:__:_:__:__: Host ID 2300____

Testing 16 Megabytes of Memory . . . Completed.
```

The monitor program starts and displays the monitor prompt.

CAUTION

Do not use the L1-A command after the auto boot process starts. Using the L1-A command when the operating system is running and the hard drive is powered up can damage your file system.

If you aborted the automatic `boot` sequence with the **L1-A** command when the hard drive was powered up, enter the following **bold** command sequence; *do not* enter any other commands:

```
Abort at PC (address)
> c <RETURN>
```

You can enter the **refresh** command from a command line prompt or select `refresh` from the workspace menu to clear the screen of any error messages.

Operating System is Running

If the MWS-E or OWS-E is booted and running the Sun operating system, you must halt the operating system to bring up the monitor program and monitor prompt.

Use the following procedure to get to the monitor prompt when the operating system is running.

1. Enter **su** to gain super-user privileges.
2. Enter the `root` password.
3. Enter the following command to ensure that all disk drive write operations are completed before the CPU is halted. If you enter this command from an OpenWindows display, ignore any error messages caused when the window server is killed.

```
mws1234# shutdown –h now
```

The system displays `shutdown` warning messages followed by the monitor mode prompt; you can now use any of the monitor program commands.

```
>
```

The system shutdown operation is logged in the `/var/adm/messages` files.

Monitor Program Commands

Enter the **h** command from the monitor prompt to display the help menu, which lists all monitor commands as shown in Figure 2-3. From the help screen, enter the command number to display more information on the commands. Enter letter commands from the monitor prompt.

NOTE: The help menu is not available on workstations with newer CPUs. However, all other commands shown in Figure 2-3 are available.

During normal MWS-E maintenance operations, only a few of the monitor commands are used: **b**, **k**, and **q**. The boot (**b**) commands are described in ‘‘Boot Options’’ on page 2-22. The **k1** command performs a software reboot; the **k2** command performs a full system reboot. The EEPROM **q** command is explained in the ‘‘EEPROM Functions’’ subsection.

```
Monitor             Rev:3.0.3           10/21/91         Help Menu

  1     b       Boot a program.
  2     k       Reset all or part of the machine or display banner.
  3     u       Initialize the input and output devices
  4     c/g/w   Resume or modify program flow
  5     d/r     Display and/or modify the registers
  6     o/e/l   Display and/or modify locations
  7     f/v     Display or modify a block of memory
  8     m/p     Display and/or modify page table entries
  9     q       Display and/or modify EEPROM locations
  10    s       Display or modify the Address Space Indent
  11    i/j     Display and/or modify cache data
  12    n/y     Disable, enable or invalidate cache
  13    ^a/^t   Display device addresses/Copy block of memory
        ^i      Display EEPROM Code Compilation Date
        ^p      Enable/disable parity interrupts
        !
        h/?
        x

'option_number'=Additional Help  <esc>=Quit  q=Quit

Command ==>
```

Figure 2-3. Monitor Program Commands Screen

EEPROM Functions

The 4300 CPU in the MWS-E and OWS-E contains an EEPROM (called the monitor) that controls the system during startup. You can read and write to the EEPROM by entering the monitor **q** command to set up various parameters as listed in Table 4. The EEPROM contains system configuration information that must be updated if the workstation configuration changes. EEPROM addresses are offset, rather than complete addresses. Each byte must be written separately.

NOTE: EEPROM values can be displayed or changed while the system is in multi-user mode by using the `eeprom` utility as described in "eeprom Utility" on page 2-18.

The **q** monitor command has the following format:

```
> q offset address <RETURN>
```

NOTE: Offset addresses must be entered as hexadecimal numbers.

Table 4. EEPROM Offset Addresses and Functions

Offset Address	Function	Default Value
0x004-0x00E	Write count and checksum	Factory set
0x010-0x013	Last hardware update	Factory set
0x14	Installed memory	0x10
0x015	Memory tested	0x10
0x016	Monitor screen size	0x13
0x017	Watchdog action	0x00
0x018	Boot device: poll for vmunix or EEPROM specified boot device	0x00
0x019-0x1D	Alternate boot device	0x00
0x01E	Keyboard type	0x04
0x01F	Primary display	0x12
0x020	Custom or Sun banner	0x00
0x021	Keyboard click	0x00
0x022-0x026	Diagnostic boot device	0x00
0x028-0x04F	Diagnostic boot path	0x00
0x050	High-resolution columns	0x50
0x51	High-resolution rows	0x22
0x052-0x057	Reserved	N/A
0x290-0x48F	Custom logo	0x00
0x58	Port A baud rate (user defined or default)	0x00
0x59-0x05A	Port A alternate baud rate	0x00
0x05B	Port A DTR/RTS	0x00
0x05C-0x05F	Reserved	N/A
0x060	Port B baud rate (user defined or default)	0x00
0x061-0x062	Port B alternate baud rate	0x00
0x063	Port B DTR/RTS	0x00
0x064-0x067	Reserved	N/A
0x068-0x0B7	Custom banner	0x00
0x0B8	Test pattern	0x0AA
0x0B9	Test pattern	0x55
0x0BC-0x18B	Configuration blocks	Factory set
0x018C	Key table selector	0x00
0x018D	Locale specifier	Factory set
0x018E	Keyboard ID	Factory set
0x190-0x20F	Lowercase key table	0x00
0x210-0x28F	Uppercase key table	0x00
0x500-0x70A	Write count and checksum	Factory set

Examples of EEPROM Parameter Changes

Use the following examples as a guide to understanding how to view and change a parameter, and also how to increment or scroll to the next parameter address.

To View a Parameter and Exit Modify Mode (no change)

Line 1: Enter **q** followed by the hexadecimal address of the parameter as shown in line 1. This example uses address 21 to display the keyboard click address.

Line 2: After entering the address, the monitor program skips a line and displays the contents (00) of address 21 as shown in line 3.

Line 3: To exit modify mode, press the space bar and **<RETURN>** key after the question mark. The monitor prompt is redisplayed as shown in line 4.

```
1   > q 21 <RETURN>
2
3   >EEPROM 021: 00? spacebar <RETURN>
4   >
```

To Increment to the Next Parameter Address

Line 3: Press the **<RETURN>** key after the question mark to display the next parameter address as shown in line 4.

Line 4: Press the **<RETURN>** key again to display the next parameter as shown in line 5.

Line 5: Press the space bar and **<RETURN>** key to quit the modify mode and return to the monitor prompt (line 6).

```
1   > q 21 <RETURN>
2
3   >EEPROM 021: 00? <RETURN>
4   >EEPROM 022: 00? <RETURN>
5   >EEPROM 023: 00? spacebar <RETURN>
6   >
```

To Change a Parameter

Line 3: Enter the new value followed by a **q** for quit and press the **<RETURN>** key. In this example, the 12 value makes the keyboard click audible (On). To change several consecutive addresses, do not use the **q** command.

```
1    > q 21 <RETURN>
2
3    >EEPROM 021: 00? 12 q <RETURN>
4    >
```

NOTE: You must reboot the system for changed EEPROM parameters to take effect.

eeprom Utility

The `eeprom` utility is used to display or change EEPROM values. You must be root user to use the `eeprom` utility to change values. Any user can enter the **`eeprom`** command to display EEPROM values, as shown in the following screen:

```
mws1234$ eeprom
hwupdate=Wed Nov  4 20:46:39 1992
memsize=16
memtest=255
scrsize=1152x900
watchdog_reboot=false
default_boot=false
bootdev=(0,0,0)
kbdtype=0
keyclick=false
console=b&w
custom_logo=false
banner=
diagdev=(0,0,0)
diagpath=
ttya_no_rtsdtr=false
ttyb_no_rtsdtr=false
ttya_use_baud=false
ttyb_use_baud=false
ttya_baud=0
ttyb_baud=0
columns=80
rows=34
secure=none
PROM bad_login=0
```

You can change EEPROM values (as root) by using the following `eeprom` utility format:

```
eeprom [field=[value]]
```

For example, you can reset the date that you last updated the workstation hardware by entering the following commands. (The date is automatically entered when you enter the time. To enter a different date, use the `DayMonthYear` format, for example `11Feb93`).

```
mws1234# eeprom hwupdate=12:11:09
mws1234# eeprom
hwupdate=Thu Feb 11 12:11:09 1992
memsize=16
memtest=16
  .
  .
  .
```

EEPROM Parameter Options

Options are available for most of the EEPROM addresses. The most relevant options are listed below by address. All addresses and option values are described as hexadecimal numbers.

014 **Mbytes of Memory Installed**
This byte defines the total number (in hexadecimal) of megabytes of memory installed in the system.

015 **Mbytes of Memory to Test on Normal Boot**
This byte defines the total number (in hexadecimal) of megabytes of memory that the firmware tests prior to booting the Sun operating system. All of memory is tested if the CPU diagnostic switch is set to the DIAG position.

016 **Monitor Screen Size**
This byte selects the screen size for the graphics display with the following options:

Value	Screen Size	Screen Type
00	1152X900	Standard screen size
12	1024X1024	Special square screen
13	1600X1280	High resolution screen size
14	1440X1440	Special square screen

NOTE: A hardware change on the CPU is needed to enable a screen size change.

018 **Operating System Boot Device**

This byte selects whether the boot PROM polls for devices on the workstation or uses the EEPROM device specified at location 019-01D for booting the operating system. Options are as follows:

Value	Definition
00	Polls workstation devices
12	Uses EEPROM device at 019-01D

019-01D **Boot Device**

These 5 bytes define a command string to boot the operating system when EEPROM address 018 is set to a value of 12 and when the CPU diagnostic switch is set to NORM. Option addresses and values are as follows:

Address	Definition
019	Default boot device (1st character converted to hex)
01A	Default boot device (2nd character converted to hex)
01B	Controller number in hex
01C	Drive number in hex
01D	Partition number in hex

01F **Primary Terminal**

With the following values, this byte selects the device for the primary terminal:

Value	Device
00	B/W monitor or monochrome with onboard frame buffer
10	Serial port A
11	Serial port B
12	Color monitor (CG6 board)
20	P4 video (Sun 4/100 only)

021 **Keyboard Click**

With the following values, this byte selects whether the keyboard is initialized with the key click option on or off:

Value	Key Click Option
00	OFF
12	ON

022-026 Diagnostic Mode Boot Device

These 5 bytes define the device that the boot PROM boots when the CPU diagnostic switch is in the DIAG position. Option addresses and values are as follows:

Address	Definition
022	Default boot device (1st character converted to hex)
023	Default boot device (2nd character converted to hex)
024	Controller number in hex
025	Drive number in hex
026	Partition number in hex

058 Port A Default Baud Rate

With the following values, this byte determines whether port A uses the default rate of 9600 baud or the rate defined by the EEPROM at addresses 059-05A:

Value	Rate
00	Default rate of 9600 Baud
12	EEPROM defined Baud rate

059-05A Port A Baud Rate

These 2 bytes define the baud rate for port A when address 058 is set to a value of 12. The first and second bytes are defined with the hexadecimal equivalent of the baud rate as follows:

Baud Rate	Hex Value	
300	01 2C	(059 byte and 05A byte)
1200	04 B0	
2400	09 60	
9600	25 80	
19200	4B 00	
38400	96 00	

060 Port B Default Baud Rate

This byte defines port B in the same manner that address 058 defines port A.

061-062 Port B Baud Rate

These 2 bytes determine the baud rate of port B in the same manner that address 059-05A defines the baud rate of port A.

Boot Options

Different options can be performed from the monitor prompt. The boot command has the following format:

```
>b device(controller#,unit#,file#)pathname args
```

Boot device information. This command lists all possible boot devices supported by the Sun operating system (SunOS) as shown in the following screen display. Only a few boot options are available on the MWS-E.

```
>b?
Boot syntax: b [!] [dev(ctlr,unit,part)] name [options]
possible boot devices:
  id: Panther (ipi) controller
  xd: Xlogics 7053 disk
  xy: Xylogics 440/450 disk
  sd: SCSI disk
  le: Sun/Lance Ethernet
  gn: Sun Generic Network
  xt: Xylogics 472 tape
  st: SCSI tape
  sr: SCSI CDROM
```

Default boot. Boots device sd, controller 0, unit 0, file 0 [sd(0,0,0)]:

```
>b
```

Boot to single-user mode:

```
>b -s
```

Boot from SCSI devices:

```
>b st()            streaming tape
>b sd()            hard disk
>b sd(,30,1) -sw   CD-ROM
```

Running Diagnostic Mode Startup Tests

The following procedure describes how to run diagnostic startup tests using the AMPEX or Falco terminal. If your Microcom modem is connected to serial port A, you must disconnect it to allow a connection for the terminal.

1. Turn off the power on the Microcom modem and disconnect its cable from serial port A on the workstation CPU.

2. Connect the terminal to serial port A with an RS-232 cable (pins 2 and 3 must be crossed).

3. Disconnect the 8-pin graphics display keyboard connector from the CPU.

4. Flip the DIAG/NORM switch on the CPU to the DIAG position.

5. Flip the power switch to OFF and back to ON.

6. The workstation executes the self-test sequence and displays the monitor prompt (>) after the CPU and memory tests are completed. You can skip the self-test sequence and move directly to the monitor mode prompt by pressing the escape key twice.

3 USER ENVIRONMENT

The maintenance workstation model E (MWS-E) runs the X11/NeWS server program to provide high-resolution display capabilities on the color graphics display. This section describes, in a quick reference format, the user and window environment for the `mws` login. Basic information and helpful hints are included to give the reader a solid understanding of the environment. Refer to the *SunOS 4.1.2 User's Guide* and the *OpenWindows Version 3 User's Guide* for more advanced user information.

Terminology

The following list briefly explains terms commonly used when describing the MWS-E user environment. You should become familiar with this list of terms:

X11 The X Window System, version 11, is a network transparent graphics window system. It supports overlapping windows and text and graphics operations on bitmapped graphics displays like the MWS-E color graphics display.

NeWS The Network extensible Window System is a Sun Microsystems, Inc. package based on the PostScript page description language.

OpenWindows The OpenWindows system provides a window environment that supports both OpenWindows and X Window System operations. OpenWindows is based on the OPEN LOOK graphical user interface. OPEN LOOK is a nonproprietary software definition.

X11/NeWS The X11/NeWS server is a combination of the X Window System, version 11, and the NeWS window system. X11/NeWS runs on top of the OpenWindows system in the MWS-E and provides the window system platform for the OpenWindows environment.

olwm The Open Look window manager (olwm) is the standard window manager for the OpenWindows system and also enables the X Window System operations. The olwm manager uses a three-button mouse to control window operations.

PostScript The PostScript language is used primarily for defining the visual appearance of printed documents. Full PostScript capabilities allow the mws login to capture and print screen/window displays. The ability to print PostScript image files is not currently available on the MWS-E.

.xhosts The **.**xhosts file contains a list of machines that can make TCP/IP network connections to the X11/News window server. The **`xhost`** command is used to add and delete machine names to the **.**xhosts file.

Standard Window Environment for the mws Login

When a user logs in the MWS-E as **`mws`**, the five-window display shown in Figure 3-1 is automatically created. There are four xterm windows and a console window, which is used to display system status and error messages. The `mws` login environment uses xterm windows to enable the use of function keys when running CRI diagnostic tests.

Each of the xterm windows can display a width of 80 characters and a depth of 24 lines. Each xterm window has a scroll bar, which may be partially hidden depending on which window is on top (these windows overlap slightly).

NOTE: The window environment shown in Figure 3-1 provides a standardized and supported environment designed to meet the needs of a typical `mws` user. This environment is supported by the Customer Service Tools department based on overall testing of the ME diagnostic release.

The xterm program is a terminal emulator program that creates a rectangular window with a shell running; the xterm window acts as a VT100 terminal. The xterm program uses a standard or common set of X Toolkit command line options.

All five windows are arranged in a hierarchy; at the top of the hierarchy is the root (workspace) window, which covers the entire screen. The workspace window runs under `olwm`; the console windows, the four xterm windows, and the CRI bitmap file are created on top of the workspace window.

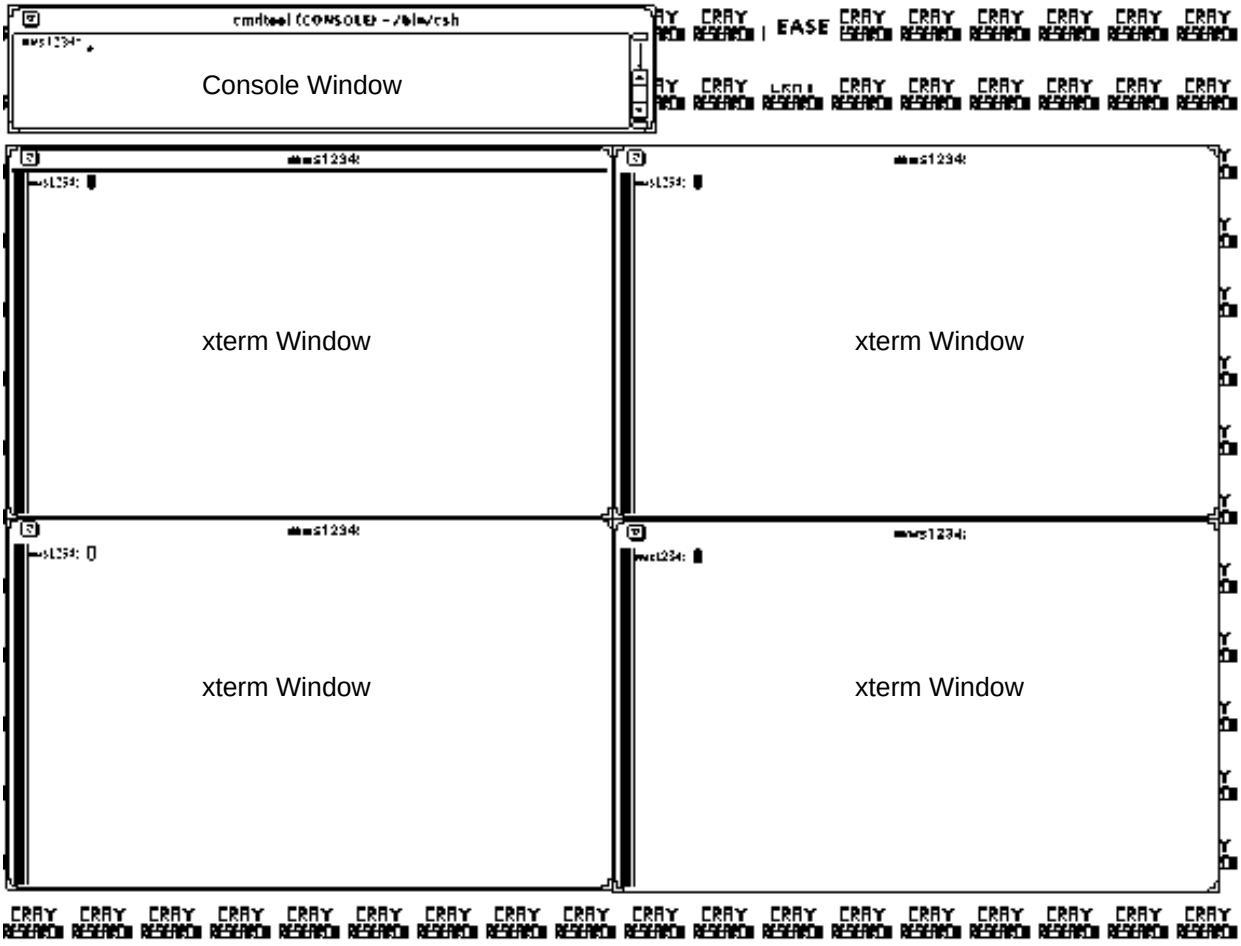


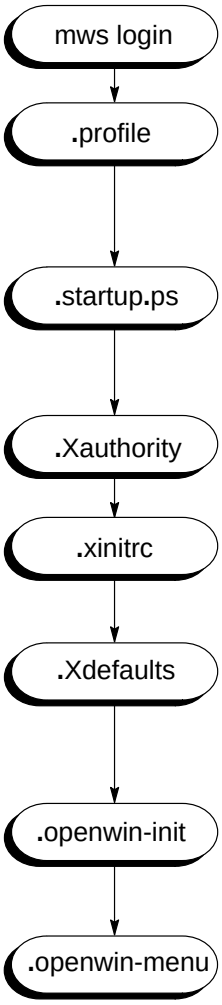
Figure 3-1. `mws` Login Screen

The console window should always be displayed; it is used to display operating system alert and warning messages. Shell tool and command tool windows are primarily the same, except command tool windows have scroll bars.

Startup Files for the mws Login

Several startup files, indicated by a dot (.) prefix, are included in the `/cri/mws` directory. After logging in as `mws`, a series of startup files is executed as shown in Figure 3-2:

NOTE: With OpenWindows 3.0, you no longer have to restart the server (log out and back in) when you edit OpenWindows startup files. These files are read whenever they are edited. Also, new startup files are created when upgrading from OpenWindows 2.0 to 3.0; these new files are created during the installation of the ME-*x.x* release. Many of the startup files used under OpenWindows 3.0 are not compatible when running OpenWindows 3.0.



This script defines the mws login environment running under the Bourne shell. The `.profile` script defines the directory pathname variable ($PATH). If the mws user logs in from the console, the OpenWindows system is started when the `.profile` script executes the `openwin` command.

This file defines the `/cri/icons/cray.ps` customized file for an OpenWindows screen parameter. The file displays a large Cray Research Proprietary banner on the screen before the OpenWindows environment is displayed.

This file enables the `/cri/mws` directory to access the X11/News window server.

This OpenWindows startup script reads the `.Xdefaults` file, starts the OPEN LOOK window manager (`olwm`), and reads the `.openwin-init` script.

This file defines default parameters used for all workspace applications. Any parameters changed by selecting *Properties* under the workspace menu overwrite the default parameters. Refer to "System Workspace Menus" later in this section.

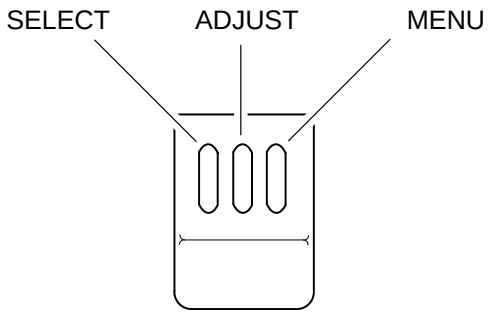
This script creates the five-window display shown previously in Figure 3-1. This script defines window sizes, locations, and colors and runs the CRI background (`/cri/icons/cri.bitmap` file).

This menu file defines all the tools that appear in the Workspace menu and submenus.

Figure 3-2. Startup File Sequence for `mws` Login

Mouse Operations

Windows and icons appearing in the workspace are controlled by using the three-button mouse. The function of each mouse button is shown in Figure 3-3.



SELECT	Select Objects or Manipulate Controls
ADJUST	Add or Reduce the Number of Selected Objects
MENU	Display and Choose Items from Menus

Figure 3-3. Mouse Button Functions

Function Keys

There are several function keys on the left-hand side of the keyboard. The most useful function keys when operating in xterm windows are as follows:

- The Front (L5) key repositions overlapped windows.
- The Open (L7) key opens icons and iconifies windows.
- The Copy (L6) key copies text; first use the SELECT mouse button at the start of text and then drag right with the mouse to highlight the text.
- The Paste (L8) key repositions text; move the cursor to the position/window in which you want to paste the text. Then press the ADJUST (middle) mouse button.

NOTE: When operating in an OpenWindows window, use the Copy (L6) and Paste (L8) keys to cut and paste text.

Window Operations

Figure 3-4 shows how to manipulate xterm windows. OpenWindows window operations are similar to xterm window operations.

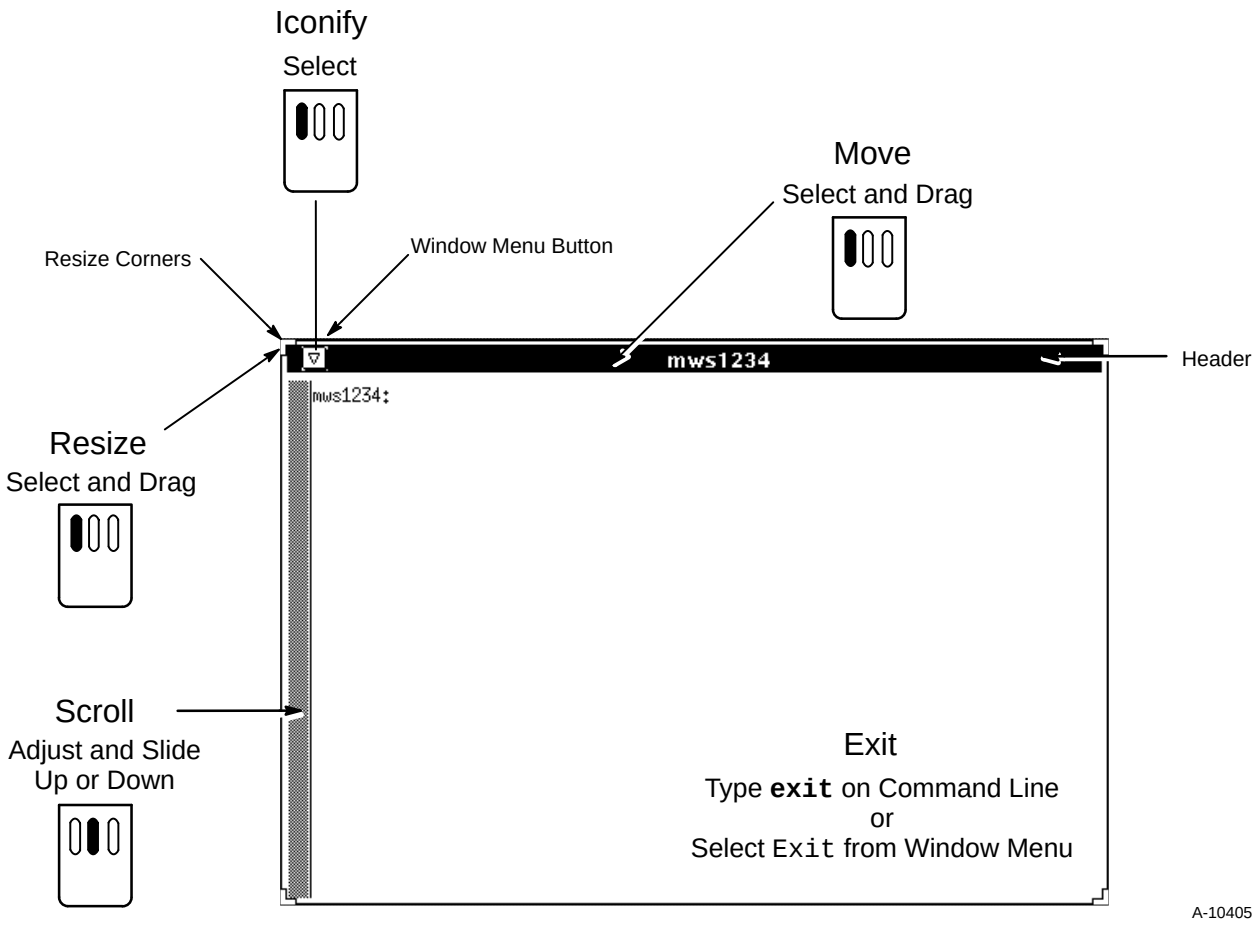


Figure 3-4. xterm Window

OpenWindows Online Help Information

The OpenWindows system has online tutorials and help information that can be accessed through the Workspace menu. Online information differs between the OpenWindows 2.0 and 3.0 versions, which are described in the following subsections.

OpenWindows 2.0 Online Tutorials

Two online OpenWindows 2.0 tutorials are available; each contains information that will help you become productive within the OpenWindows environment. The tutorials consist of self-guided instructions. The tutorials can be accessed by entering either of the following commands from the `mws####` prompt:

- `Workspace Programs` desktop introduction (shown in Figure 3-5)

```
/usr/openwin/demo/online_intro/intro_start
```

- OpenWindows command line tutorial (shown in Figure 3-6)

```
/usr/openwin/demo/tutorial/tutorial.sh
```

These tutorials describe many OpenWindows features that some `mws` login users may seldom use. However, they are very helpful in teaching inexperienced users how to use and control the mouse, windows, and other basic features. The tutorials are described in detail in the *OpenWindows User Training Tutorial Guide*, Sun Microsystem, Inc. part number 800-5308-10.

NOTE: You can display the `intro_start` tutorial in either French or German by moving to page 36 in the tutorial and double-clicking on the appropriate button as shown in Figure 3-7.

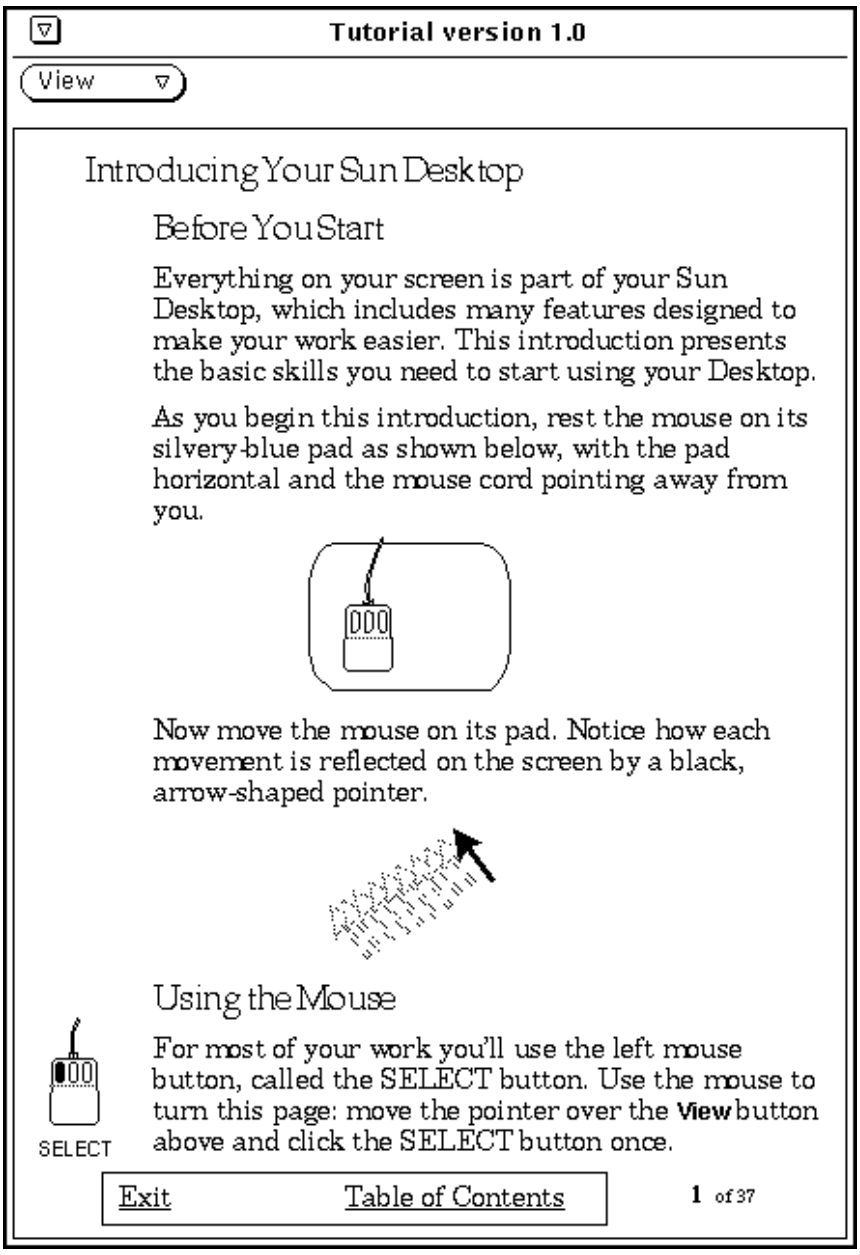


Figure 3-5. OpenWindows 2.0 Tutorial Introductory Screen

Figure 3-6. OpenWindows 2.0 Command Line Tutorial Window

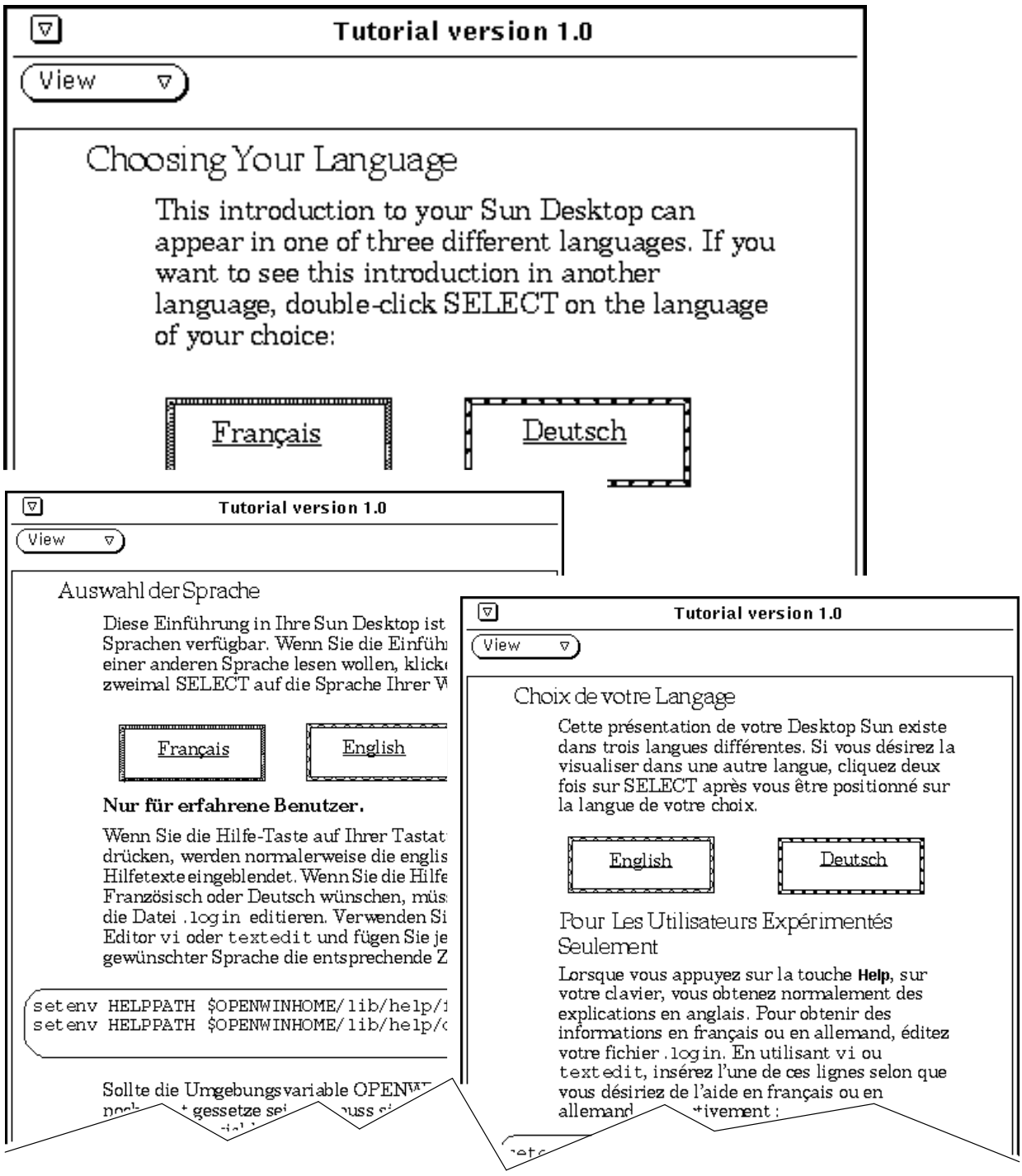
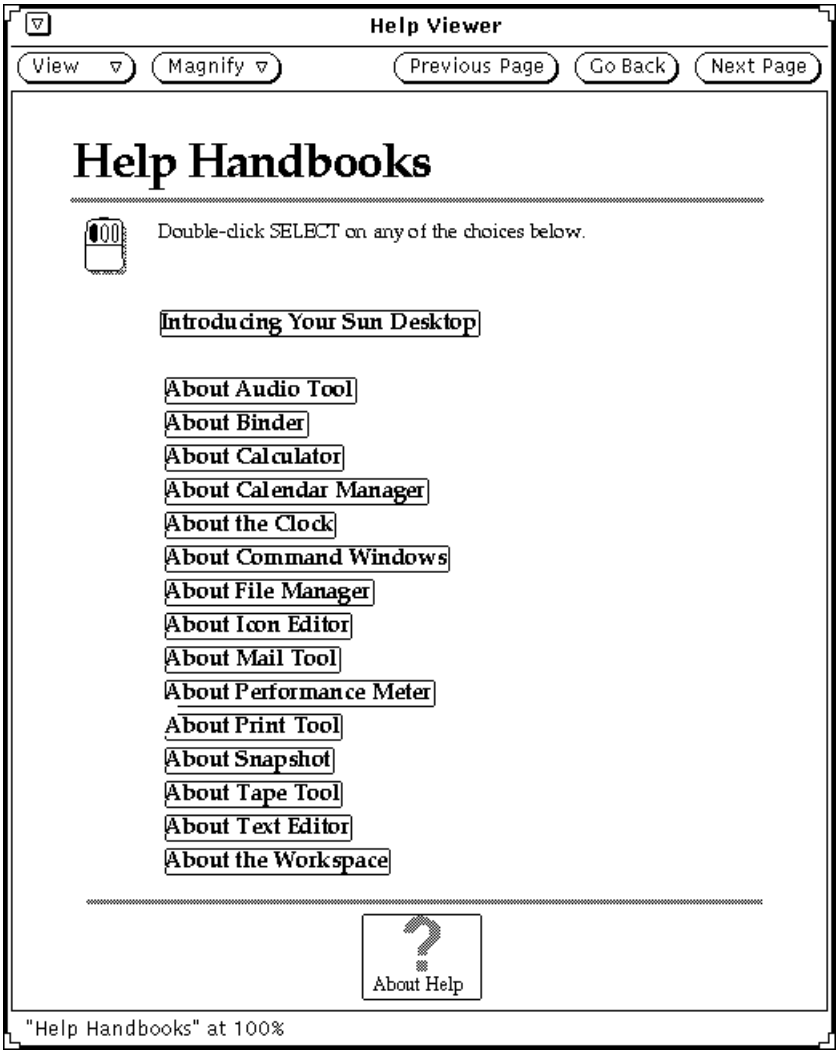


Figure 3-7. OpenWindows 2.0 Tutorial in German and French

OpenWindows 3.0 Online Help

There are two kinds of online help available in OpenWindows 3.0. This help information is displayed in the `Help Viewer` window, which is an OpenWindows 3.0 application based on PostScript that is used for viewing and navigating through online information.

The two kinds of help information are the Sun Desktop tutorial and the quick-reference Help Handbooks. Each can be accessed by an option on the Workspace menu by selecting the `Desktop Intro` and `Help` options, respectively. The Help Handbooks (Figure 3-8) provide information on individual OpenWindows topics. The Desktop Introduction (Figure 3-9) provides an introduction to OpenWindows basics and is designed to be read sequentially. Double-click SELECT on the `About Help` question mark at the bottom of the `Help Viewer` window to get more information about the help system.



Help Viewer Icon

Figure 3-8. Workspace Help Window

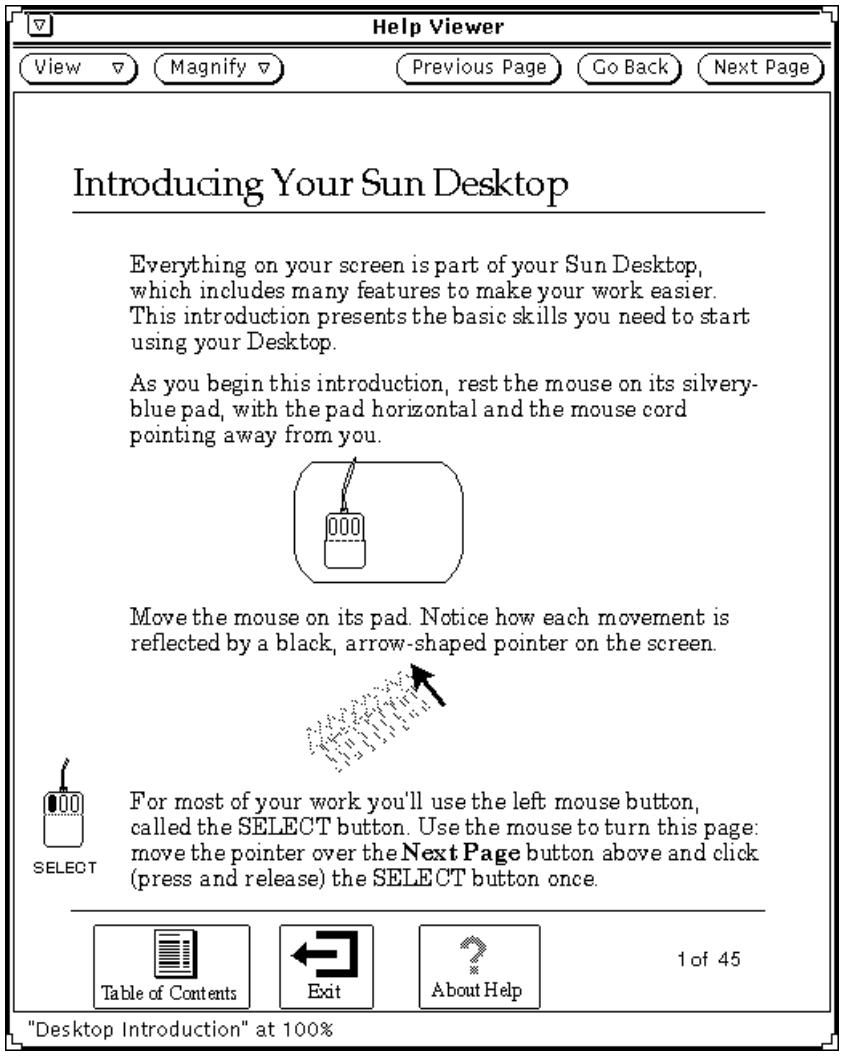


Figure 3-9. Workspace Desktop Introduction Window

International Keyboard Setup

You can configure your keyboard to any of the several international keyboards that are available in (supported by) OpenWindows 3.0. International keyboards are supported for use in XView applications like command tool and shell tool windows; these keyboards are not supported when typing in `xterm` windows.

The following steps describe how to set up an international keyboard.

1. Display the `Function Keys` window shown in Figure 3-10 by performing either of the following two steps:

- Position the mouse cursor in your console window. Then press and hold the `R2/PrSc` key.

- Press MENU to choose the `Utilities -> Function Keys` option from your Workspace menu.

Figure 3-10. Function Keys Window

2. Click SELECT on the language button you want to use. Click SELECT on the More button to display additional languages.

3. Click SELECT on the Show button to display the virtual keyboard for the language you selected. The German keyboard is shown in Figure 3-11.

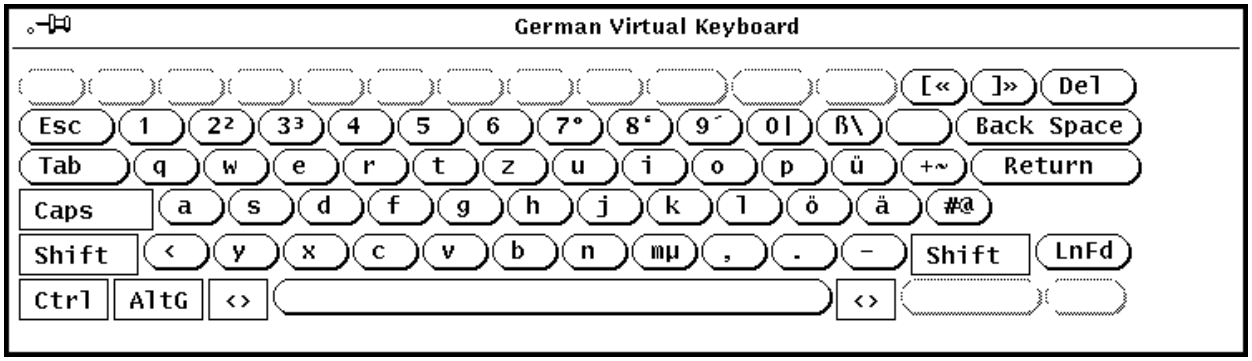


Figure 3-11. German Virtual Keyboard

4. Click SELECT on the Set button to set the virtual keyboard.

Switching between Virtual Keyboards

You can temporarily switch to a different keyboard language to type a few characters and then return to your usual language. Use the following steps to switch to a different keyboard and then return to your normal keyboard:

1. Begin entering text using your normal keyboard.

2. Press and hold down the `R2/PrSc` key.

3. Click SELECT on the language button you want to temporarily use. Continue to hold down the `R2/PrSc` key.

4. Type the characters you want from the new keyboard language.

5. Release the `R2/PrSc` key to return to your normal keyboard language.

Left-handed Mouse Setup

Left-handed users can change the default mouse button positions as shown in Figure 3-12. The order of the mouse buttons can be changed (remapped) by using the `xmodmap` utility. Your mouse buttons can be temporarily remapped by entering the following command from an `xterm` or command tool window. To permanently remap your mouse buttons, enter the following command before the `wait $pid` line in `.xinitrc` file. Then log off and back on (restart OpenWindows) to invoke the new button assignments. To reset the mouse buttons for right-handed users, change the position of the `1` and `3` numbers and re-enter the `xmodmap` command.

```
xmodmap –e “pointer =3 2 1”
```

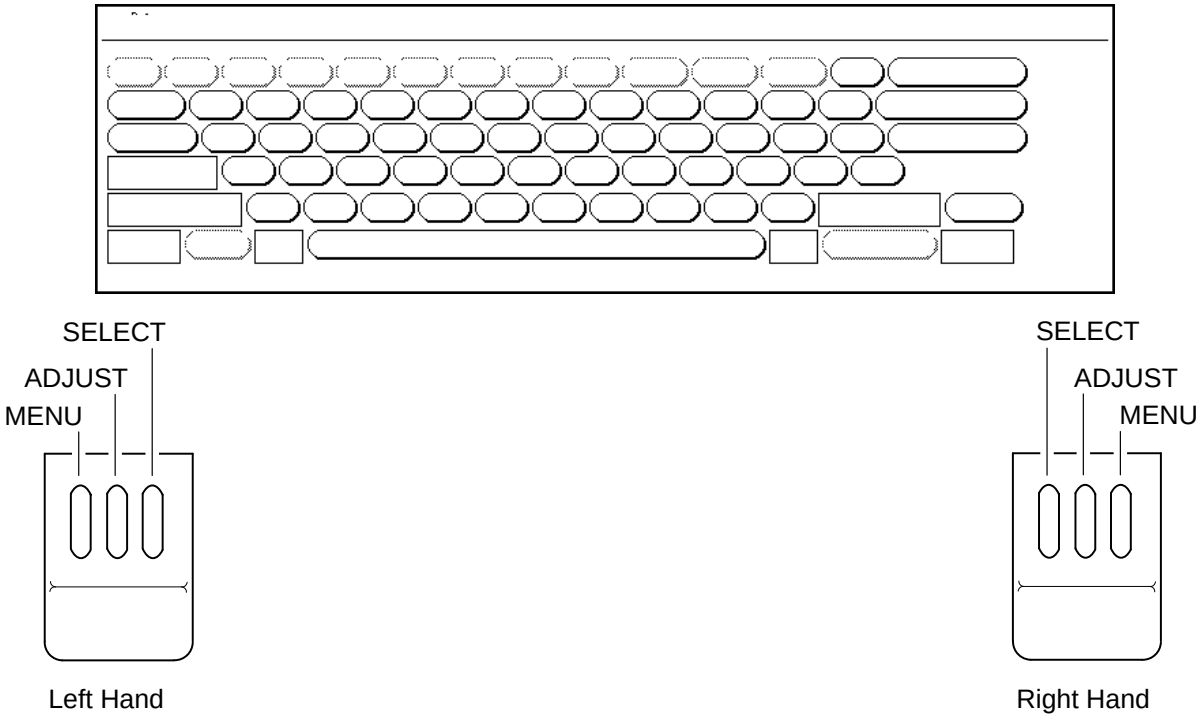


Figure 3-12. Right- and Left-hand Mouse Buttons

System Workspace Menus

The Workspace main menu and Programs and Utilities submenus are different for CRAY Y-MP and CRAY Y-MP C90 systems as shown in Figure 3-13 and Figure 3-14; please make note of the CAUTION statement. Changes made to the window environment using the `Save Workspace` and `Properties` options change/delete default parameters within mws login startup files.

To display these menus, place the mouse cursor on a blank area of the workspace, press the mouse's MENU button, and drag the mouse to the right. Most of the menu selections should be self-explanatory and therefore are not described in this section. Refer to the *OpenWindows User Guide* for detailed information.

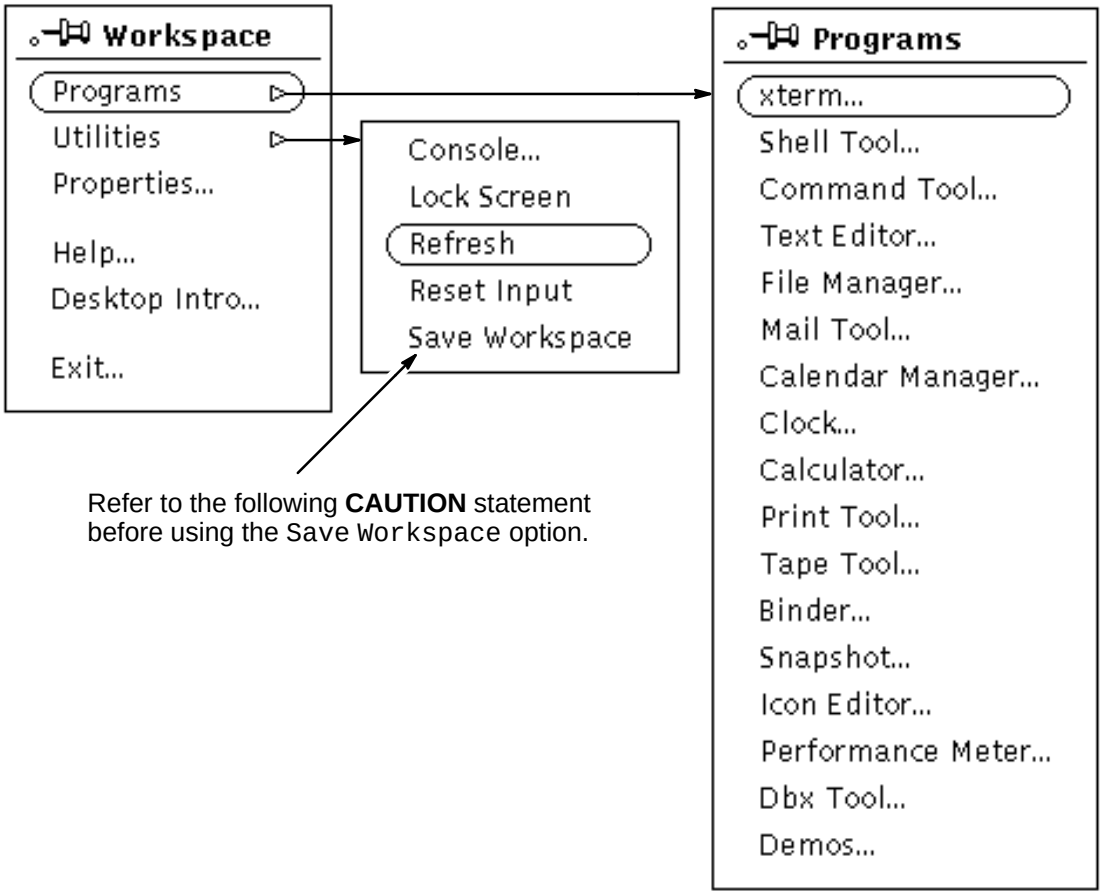


Figure 3-13. CRAY Y-MP Workspace Menus

CAUTION

The Save `Workspace` option modifies the `.openwin-init` file and erases the `cri.bitmap` file. The `.openwin-init.me-2.0` file is an original copy of the `.openwin-init` file.

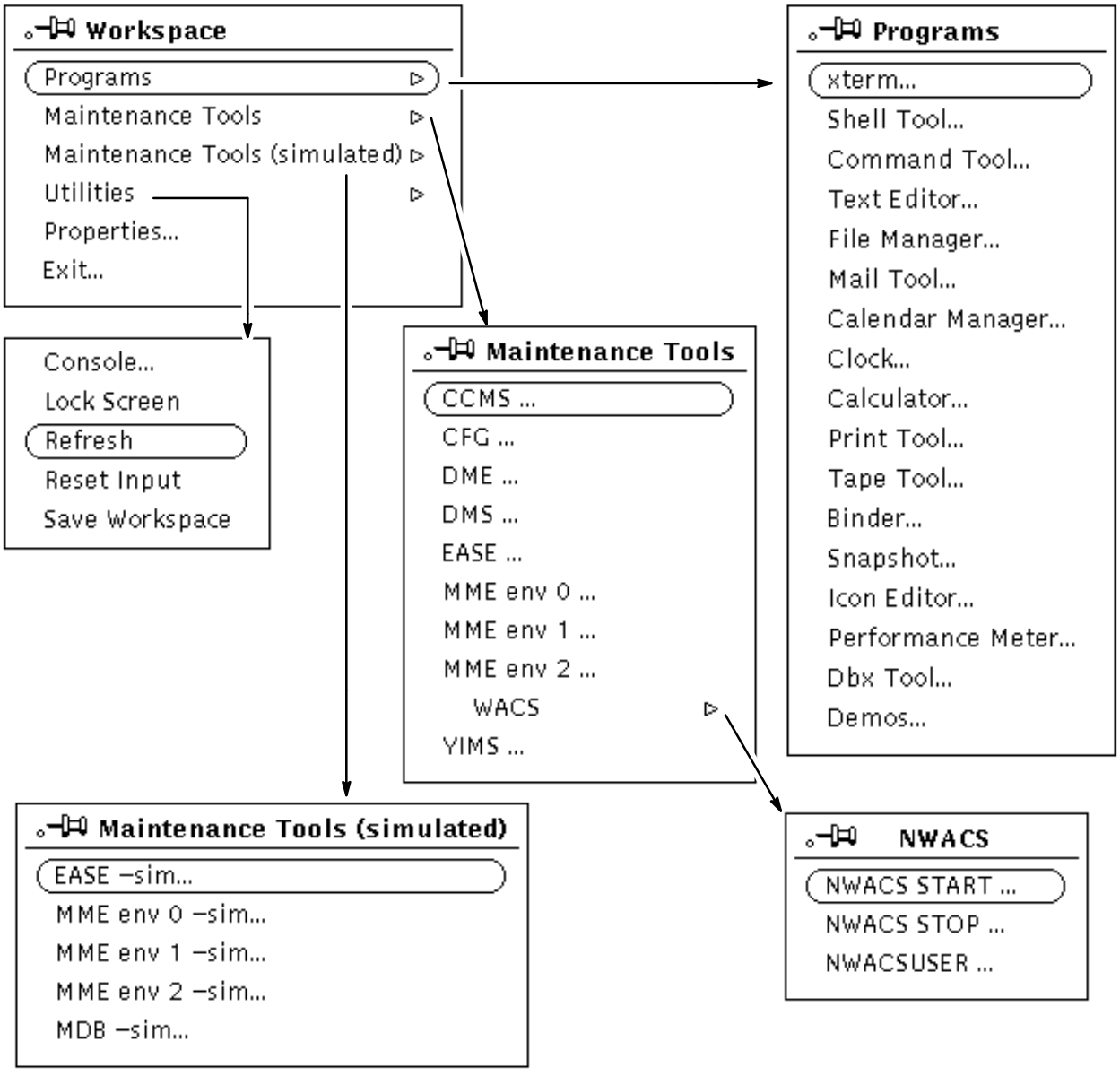


Figure 3-14. CRAY Y-MP C90 Workspace Menus

Icons

Figure 3-15 illustrates the cycle of mouse operations used to manipulate workspace icons and windows. The clock program shown is available from the workspace program menu, along with other application programs.

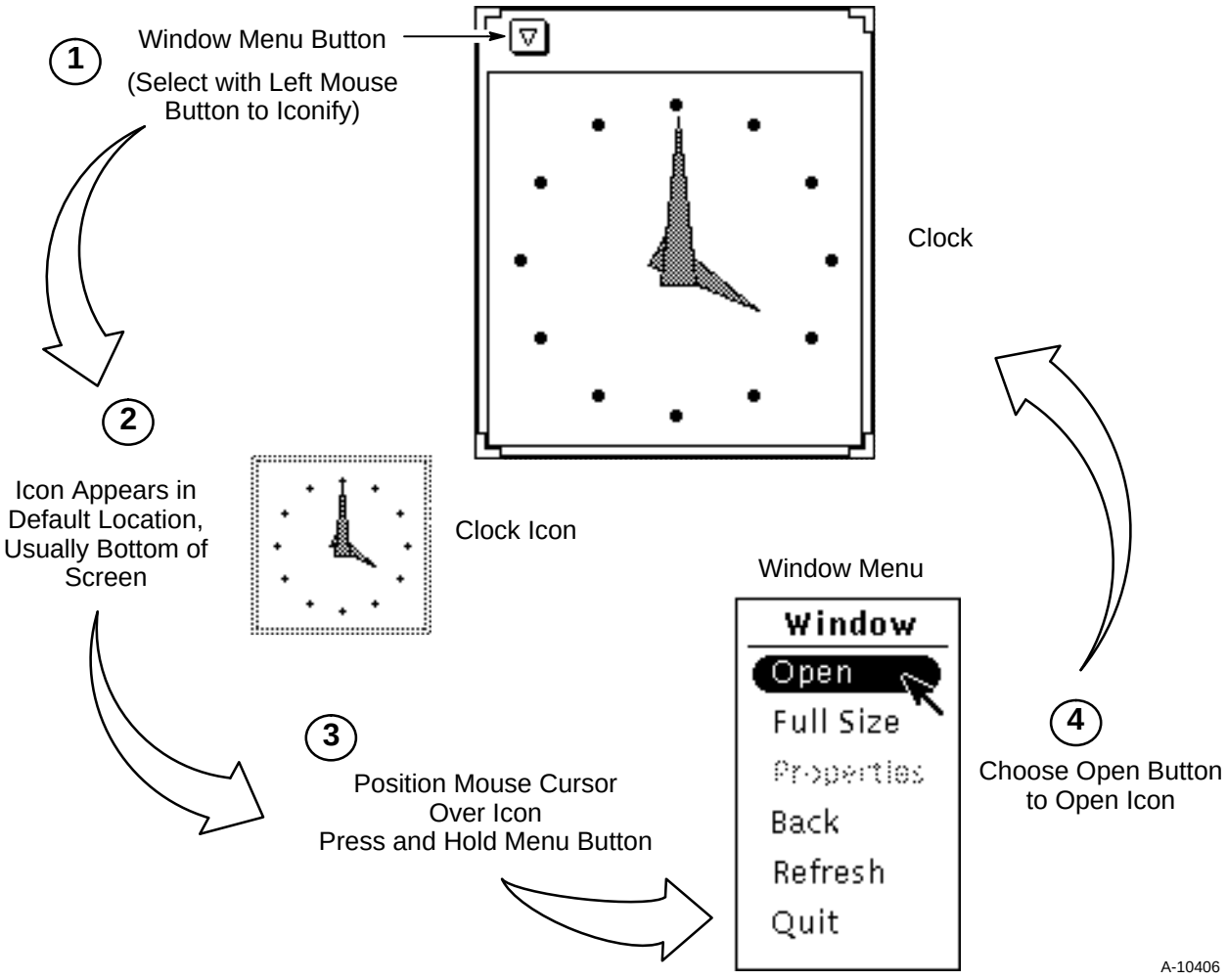


Figure 3-15. Icon Operational Cycle

Screen Saving Commands

The following commands can be used to turn off the screen display when it is not used for extended periods. These commands help eliminate phosphorescent burn images from developing on the graphics display terminal. Both commands preserve the state of the graphics display while the screen is blank or locked.

Screenblank

The `screenblank` command is used to turn off the screen when the mouse and/or keyboard are idle for a specified period of time. The following command line placed in the `/etc/rc.local` file causes the screen to go blank after the keyboard and mouse are inactive for 5 minutes (300 seconds).

```
screenblank –d 300
```

After placing this command into the `/etc/rc.local` file, use the **`fastboot`** command to `reboot` the system, which reads the altered file and invokes the `screenblank` command. Once invoked, the `screenblank` command continues to run and turns off the screen whenever the mouse/keyboard are left idle for the specified time. You can discontinue the `screenblank` command by using the **`kill`** ***`process_id`*** command. Use the **`ps –ax`** command to find the process ID number.

Lockscreen

This command locks the screen and allows access only for the user who invoked it; the user's password is required before the screen display is restored. This command can be invoked in two manners: from the command line and from the workspace menu.

- Entering **`lockscreen`** on the command line locks the screen and causes a set of blue Sun logos to bounce around the display screen.
- Selecting the `Utilities –> Lock Screen` menu selection from the Workspace menu locks the screen and causes a colored, amorphous figure to bounce around the display screen.

After the `lockscreen` command is invoked, access to the console can be made only by entering the password for the `login` that invoked the `lockscreen` command.

4 MAINTENANCE & DIAGNOSTIC ENVIRONMENT

This section provides an overview of the model E maintenance (ME) offline diagnostic system release and file structure for CRAY Y-MP and CRAY C90 series systems. The Cray Research, Inc. (CRI) proprietary diagnostic directories run under the MWS-E operating system in the `/cri` file partition as illustrated in Figure 4-1 and Figure 4-2. A list of related diagnostic manuals is included in the ‘‘Diagnostic and Maintenance Publications’’ subsection.

Working Directories

Numerous working directories are created during the ME diagnostic installation procedure as illustrated in Figure 4-1 and Figure 4-2. The `/cri/mws` directory is the home directory and current working directory for the `mws` login. You can run diagnostic software and perform maintenance activities from the `mws` directory; all other working directories are created under the `/cri` directory. Figure 4-1 shows the directory structure used by MWS-E offline diagnostic software.

The following list briefly describes the working directories for Cray Research, Inc. (CRI) offline diagnostic software:

Directory	Type of Files
bptsys	Contains IOSE binary files corresponding to the BPT0 basic processor boot test.
cbtsys	Contains mainframe binary files corresponding to the CBT0 diagnostic boot test.
cftsys	Contains mainframe binary files that correspond to the CFT0 diagnostic boot test.
cmspre	Contains prereleased diagnostic tests under control of the Cray maintenance system (CMS).
cmssnaps	Contains snap and log files created under control of CMS.
cmssys	Standard release CPU diagnostic binary files. These binary files are configured for your mainframe during system installation using the **`/cri/bin/config`** command. This directory is read only.

Directory	Type of Files
cmsuser	Contains CPU diagnostic tests that are modified, reconfigured, and saved when running the CMS.
dmeflaw	Default directory that contains device maintenance environment (DME) load and save flaw tables.
dmepre	Contains prereleased diagnostic tests that run under control of DME.
dmesys	Contains DME diagnostic utilities and microcode.
dmeuser	Stores any DME screen snaps, user-modified tests, or files a user may create and save.
dmpsys	Contains dmp file program binary files. The dmpsys directory is loaded by the dmp file after a memory dump is requested from the mainframe.
dmpuser	Stores user-created dmp files.
dmspre	Contains prereleased diagnostic tests that run under the device maintenance system (DMS).
dmssys	Contains diagnostic binary files that run under DMS.
dmsuser	Stores user-saved diagnostics.
easefiles	Contains unreadable error logger files created by the `ease` program.
elogfiles	Contains unreadable error logger files created by the elog program.
ememsys	Contains the `emem0` memory boot test.
iose.config	Contains parameter settings for IOS-E diagnostics.
lst	Contains diagnostic listing files that are read by using the **`cfpg <listing>`** command and printed by using the **`cfl`** command.
mdms	Contains microbased disk maintenance system (MDMS) binary files.
memsys	Contains the help.mem0 file: a help file for the `mem0` level 0 memory test.

Directory	Type of Files
mf.config.ymp	Contains parameter settings for mainframe diagnostics.
pmnotify.*xxx*	Part of the preventive maintenance utility that sends the `mws` login E-mail messages of scheduled maintenance activities. Refer to Section 4, "Preventive Maintenance" in the *MWS-E and OWS-E Hardware Maintenance Manual* for more information.
ssdeuser	Used for temporary storage of test files used by the SSDE maintenance system.
sysclr	Contains files that are used to remove residual or stored data from the mainframe, IOS-E, and SSD-E. Refer to Section 10, "System Clear Utility," for more information.
wacs	Contains WACS configuration table and log files specific to each site. The `wacstab` file is created by the `wacscfg` program.
wmt0.hlp	Is a help information file called by the workstation multiplexer test (`wmt0`).
ybugs	Contains bugfiles for the CRAY Y-MP and CRAY X-MP simulator (YSIM). These files contain code that simulates hardware errors when you use the `ybug` shell script.
yimspre	Contains prereleased diagnostic tests under control of the YIMS operating system.
yimssnaps	Contains snap files created under control of the YIMS operating system.
yimssys	Contains IOP diagnostic binary files, which run under control of the YIMS operating system. The diagnostic tests are configured for your mainframe during system installation. The imssys directory is read only.
yimsuser	Contains IOP diagnostic tests that are modified and saved when running the YIMS operating system.

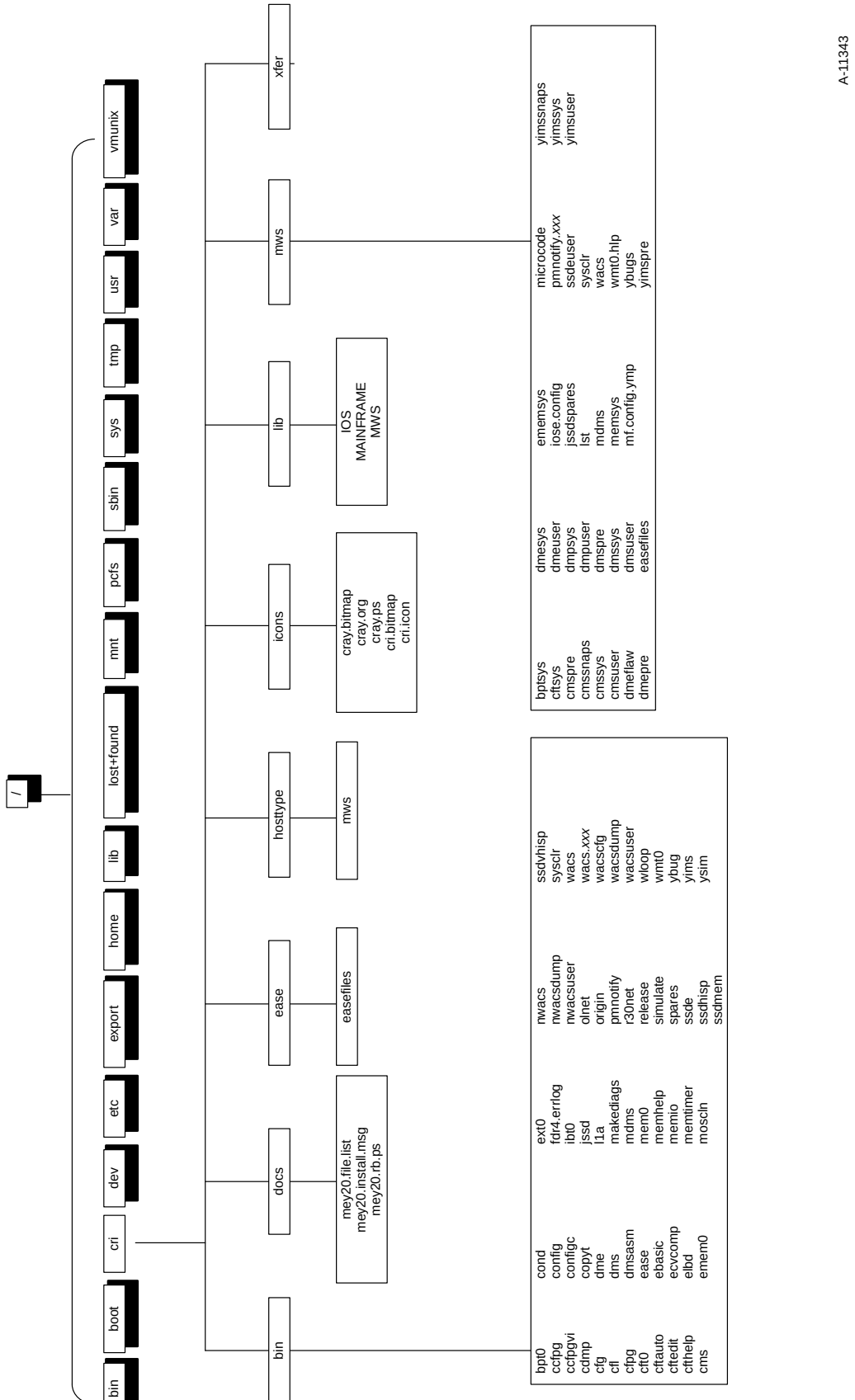


Figure 4-1. ME-Y2.0 Directory Structure

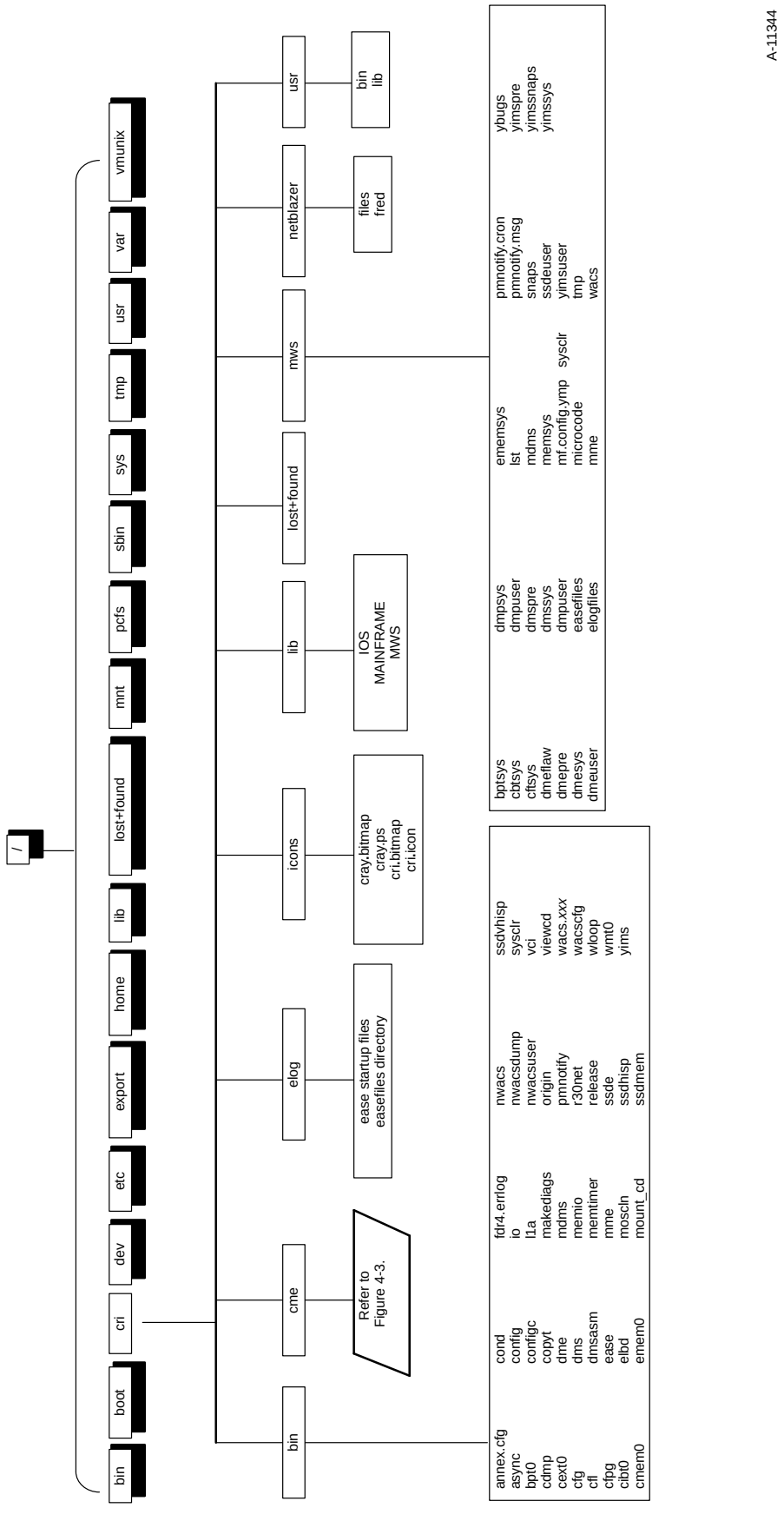


Figure 4-2. ME-C1.0 Directory Structure

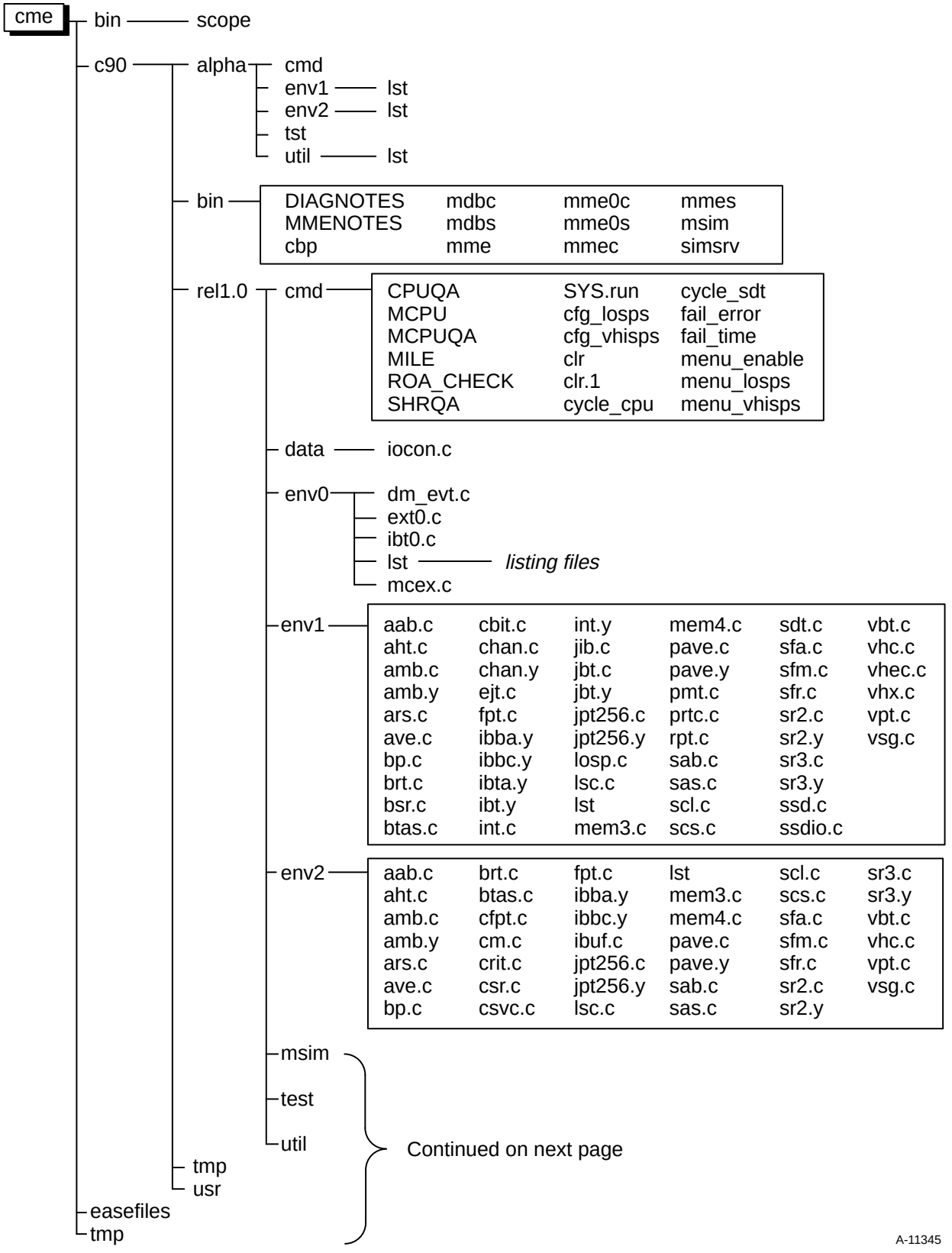


Figure 4-3. ME-C1.0 CME Directory Structure (Sheet 1 of 2)

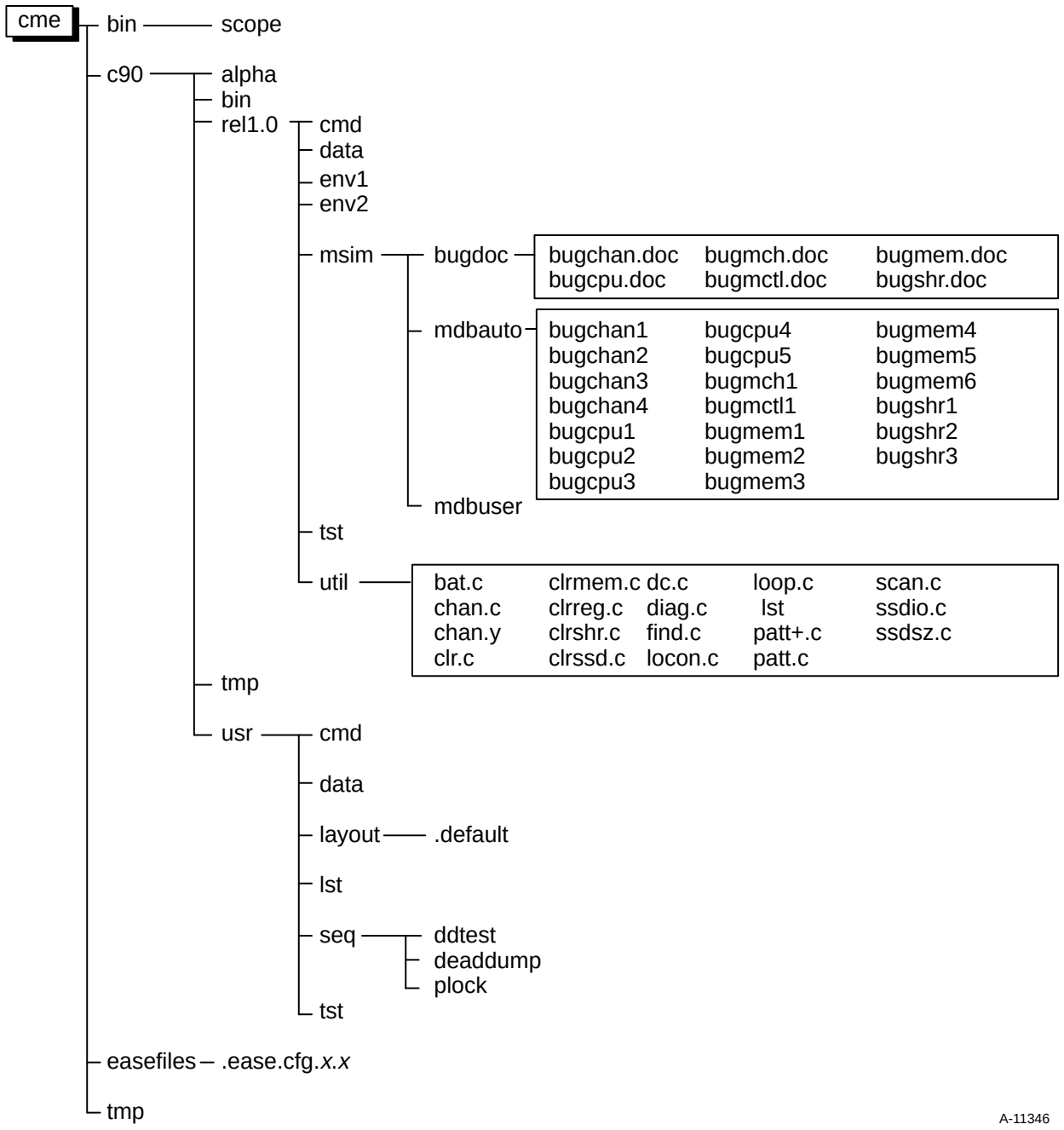


Figure 4-4. ME-C1.0 CME Directory Structure (Sheet 2 of 2)

Binary Files

Offline diagnostic binary files are created under the `/cri/bin` directory during the installation of the ME offline diagnostic package as illustrated in Figure 4-1 and Figure 4-2. Each of these files is an executable program: either a user-oriented diagnostic test or a utility required by a diagnostic test.

The following utilities are Cray Research application programs written for the mws login:

dial –a dial**ccfpg**
: This utility is an alternative to the `cfpg` utility, both are used to display diagnostic listings. The `ccfpg` utility is described on page 4-21.

dial –a dial**cfl**
: This utility allows the `mws` login to print online diagnostic listings as described on page 4-22.

dial –a dial**cfpg**
: This utility is used to display listings as described in ‘‘Displaying Online Diagnostic Listings’’ on page 4-18.

dial –a dial**copyt**
: This utility allows you to copy UNIX-based streaming tapes. The `copyt` utility is described in ‘‘Copying UNIX Tapes’’ on page 5-23.

dial –a dial**moscln**
: This command is used to inform the Cray maintenance system (CMS) software driver which IOS cluster is running the mux operating system (MOS).

dial –a dial**mount_cd**
: This CRAY Y-MP C90 command mounts compact discs written in High Sierra file system (hsfs) format under the `/cdrom` directory. This command was created because the `mount` command requires root access; the `mount_cd` command allows any user to mount a compact disc (CD). The `mount_cd` command must be owned by root and have the set uid permission set. The `mount_cd –u` option unmounts the CD. The CD must be unmounted before you can eject it from the CD-ROM player.

dial –a dial**nwacs**
: This command starts the new WACS software program, which is a point-and-click window that runs under the OpenWindows environment.

dial –a dial**pmnotify**
The preventive maintenance notification utility notifies an operator using the `mws` login of scheduled system maintenance activities by sending E-mail messages. The `pmnotify` utility is described in Section 4, ‘‘Preventive Maintenance,’’ of the *MWS-E and OWS-E Hardware Maintenance Manual*, publication number CMM-1122-0C0.

dial –a dial**r30net**
This program is included for sites that use the Telebit NetBlazer for a remote support connection to a Communication Hub. The program edits operating system networking files and writes configuration information and addresses for your site. This program is described in Appendix B of the *ME-Y2.0 Release Bulletin*.

dial –a dial**release**
Entering the **`release`** command displays the release levels of the software installed on your MWS-E. This information is stored in the files in the `/cri/lib` directory.

dial –a dial**simulate**
This program is used with the `cft0` level 0 CPU function test. It is used to test user-created instruction lists run on the MWS-E and to compare them to the results of the same instructions run on the mainframe CPUs. Refer to the *CRAY Y-MP and CRAY X-MP EA Offline Diagnostic Reference Manual*, publication number CDM-1116-0B0, for further information.

dial –a dial**spares**
The spares utility is a menu-driven program that provides a means of mapping the spare DRAM chips in place of faulty DRAM chips on the SSD-E/32i. The SSD-E/32i contains 12 spare DRAM chips that can be remotely programmed by the spares utility. Refer to the *SSDE and JSSD Maintenance Systems User Guide*, publication number CDM-1019-0A0, for detailed information.

dial –a dial**ssde and ssdeuser**
The `ssde` command invokes the SSD-E Maintenance System (SSDE), which is a diagnostic environment used to troubleshoot the SSD-E. The `ssdeuser` directory stores snaps created while the `ssde` command is run. Refer to the *SSD-E, SSD-E/32i, and SSD-E/128i Maintenance Systems User Guide*, publication number CDM-1019-0B0, for detailed information.

dial –a dial**sysclr**
This program is used to clear residual or stored data from different areas of the CRI computer system as described in Section 10, “System Clear Utility.”

dial –a dial**viewcd**
: This program is used to view Engineering Documentation files on the compact disc (CD) sent to CRAY C90 sites. The `viewcd` command will mount the CD if it is not already mounted. Refer to Page 4-27 for instructions on using `viewcd`.

dial –a dial**wloop, cond, configc, and makediags**
: These programs are called by the `config` shell script during the diagnostic configuration process as described in the following pages.

dial –a dial**ybug and ysim**
: These commands are part of the CRAY Y-MP and X-MP EA instruction-level simulator (YSIM). Refer to the *CRAY Y-MP and X-MP EA Simulator User Guide*, publication number CDM-0414-000, for complete information.

Diagnostic Configuration (config)

The `config` shell script is used to configure CRAY Y-MP diagnostics. You must have root privileges to run the `config` shell script.

The `config` command allows you to configure diagnostics to your particular site. When diagnostic tapes are first installed, the installation program loads your diagnostics and initiates the configuration process by running the `config` program; the current diagnostic Site Installation Bulletin lists the procedure for the diagnostic installation. However, at some later time it may be necessary to reconfigure your system; for example, you need to reconfigure it if you need to recable the MWS to different channels.

The `config` command has the following format:

```
/cri/bin/config [-m –i –sk –fm filename –fi filename]
```

The square brackets indicate an optional entry.

Option	Description
`-m`	Mainframe diagnostics configuration.
`-i`	IOS diagnostics configuration.
`-sk`	Skip `cfg`.
`-fm`	Configure mainframe diagnostics without using one of the standard diagnostic configuration files supplied with the ME release.
`-fi`	Configure IOS diagnostics without using one of the standard diagnostic configuration files supplied with the ME release.
`-f`	Filename specification. This option supersedes the default file name that the `config` program uses. This option allows you to give a user-defined file name that the `config` program will search for and use.

config Procedure

To reconfigure your CRI computer system, perform the following steps:

1. Log in as `root`.
2. Enter the `config` program to configure your system.

   NOTE: A SunOS `config` command exists that is different from the Cray Research configuration program. Running the `/cri/bin/config` shell script after logging in as root runs the Cray Research diagnostic configuration programs.

```
/cri/bin/config
```

3. If you have not run `cfg` (no `cfg2.0` file exists in the `/cri/mws` directory), the screen shown in Figure 4-5 appears. Go to Step 4.

   If you have already run `cfg`, the screen shown in Figure 4-6 is displayed; skip ahead to Step 5.

```
cfg MWS Configuration Utility                                          Rev 2.0
Thu Jan 14 16:12:35 1993                Last File Save:  Tue Dec 29 15:29:43 1992
================================================================================
M-mainframe        I-ios        S-ssd               L-MWS LOSP chan     P-printer
E-err log chan     U-update     D-discard changes                       X-EXIT
================================================================================
SPACE BAR changes toggle field (*) values          RETURN advances to next field
ENTER (type) non-toggle field values                   ARROW KEYS to change field
================================================================================

================================================================================
General System Information

                        site name  [         ]

       serial number   [1001]                  mainframe type   [YMP   ]*

           IOS model   [E]*              dual i/o subsystems   [no ]*

           SSD model   [E]*     number of error logger boards   [1 ]*
```

Figure 4-5. cfg Main Menu

4. Enter your site configuration data including error logger configuration data. Use the **U** command to update your configuration file.

```
Your system is configured with following Mainframe and IOS types: YMP–xx
YMP
IOS–E

Select what diagnostics you want configured:

1) YMP–xx only
2) IOS–E only
3) YMP–xx and IOS–E
4) Print usage
5) Quit without configuring any diagnostics

Select desired configuration (or 5 to Quit) [1 – 5]:
```

Figure 4-6. config Diagnostic Menu

5. Enter the desired configuration type.

   NOTE: With this revision of `config`, you can configure only mainframe diagnostics; you cannot configure IOS diagnostics. Each IOS diagnostic must be configured manually.

   The following configuration information screen is displayed:

```
You are about to configure the diagnostics for the following Diagnostic Release
revision levels:

MWS Release:             ME-Y2.0
Mainframe Release:       Y2.0
IOS Release:             IE1.2

The first step of the configuration process will be to use the ”cfg”
program.  This will configure the level 0 diagnostics, and set up
your site configuration for the level 1 and 2 diagnostics.  As a
minimum, you MUST complete the mainframe and IOS configuration at
this time.  After completing the configuration, use the U option
on cfg to update your configuration and continue.

Press <RETURN> to begin configuration, or press your interrupt key
(CTRL-C) to abort the configuration.
```

6. Press the **<RETURN>** key to begin configuring mainframe diagnostics. The following information is displayed:

```
cfg:  start up
cfg:  creating backup file
The level 0 diagnostics are now configured.  Based on the information
that you supplied while in cfg, the level 1 and level 2  Yx.x diagnostics will
now be configured.

Press <RETURN> to continue the configuration, or press your interrupt key
(CTRL–C) to abort the configuration.
```

7. Press the **<RETURN>** key to continue configuring the appropriate diagnostics to the specifications you made in `cfg`. Diagnostic configuration begins and the following information is displayed.

```
Processing the MF.CONFIG file
Total number of diagnostics to be processed: 104
Processing diagnostics ....
    5 diagnostics processed
   10 diagnostics processed
    .
    .
    .
  100 diagnostics processed
  104 diagnostics processed
Diagnostic processing completed.

104 diagnostics were successfully modified, the results can be found in /cri/mws/
config.mods

 0 diagnostics were unsuccessfully modified, the results can be found in /cri/mws/
config.errs

Unlinking monitors.
Linking configured monitors.

Your site has been configured for the following Diagnostic Release revision lev-
els:

MWS Release:             ME–Y2.0
Mainframe Release:       Y1.2
#
```

8. The `config` process is complete; enter **`exit`** to log out of the root login.

System Configuration (cfg)

The `cfg` utility allows you to modify MWS-E LOSP and error logger channel assignments. The `cfg` utility also configures level 0 diagnostics without configuring the level 1 and level 2 diagnostics.

1. To run `cfg` without running `config`, enter the following command:

```
mws1234: cfg
```

   The `cfg` main menu is displayed as shown in Figure 4-7. The `cfg` program is menu driven; commands are listed on the top half of the menu screen.

NOTE: The currently selected parameter field is displayed in yellow, reverse-video text. You can use any of the three mouse buttons to select any fields and commands; you can also use the mouse to cycle through choices of fields marked with an asterisk (*).

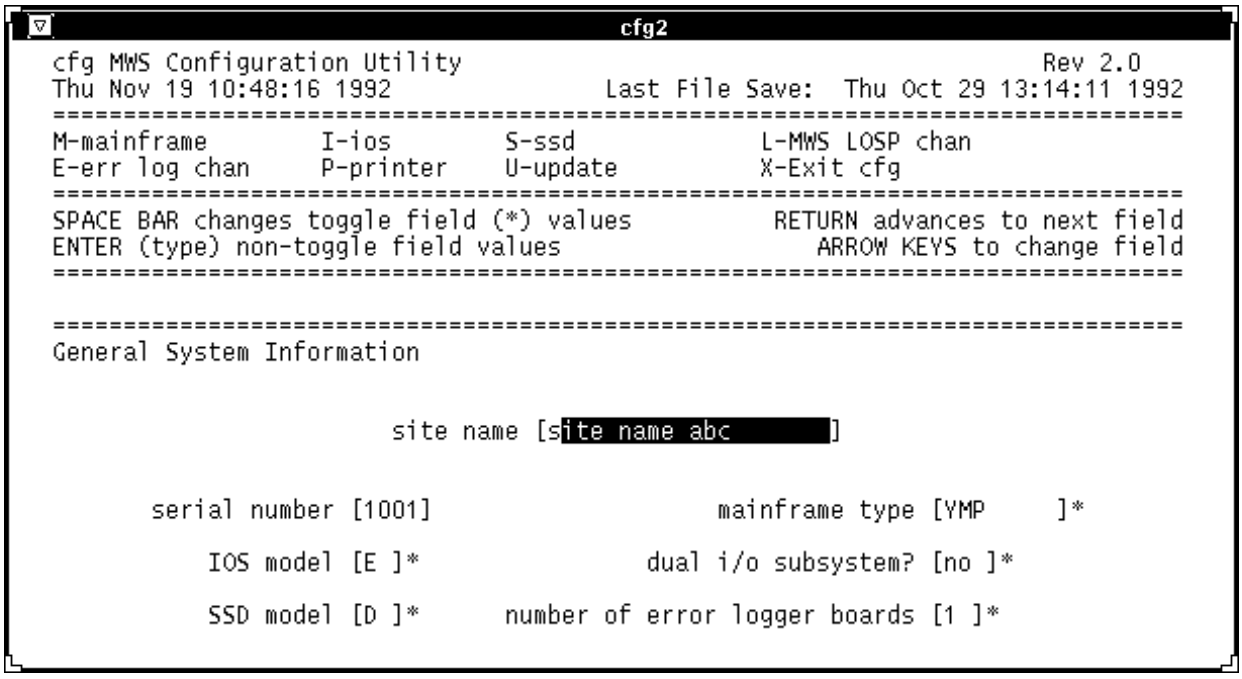


Figure 4-7. MWS-E cfg Configuration Utility

2. Start entering your system name and serial number into the appropriate fields. Please enter your 4-digit serial number into the `serial number` field.

   NOTE: The `cfg` program does not accept capital letters. Use lowercase letters when entering text into any `cfg` parameter field.

   After entering text into fields that are not marked with an asterisk (*), you must press the **<RETURN>** key before `cfg` will save your entry.

3. Enter the appropriate configuration data for your site into each of the `cfg` submenus (mainframe, IOS, SSD, printer, and MWS LOSP channel).

4. After you make the necessary changes, enter **U** to create a new configuration file (`/cri/mws/cfg2.0`).

   The new `cfg2.0` file replaces the current file, which is renamed `cfg2.0_bak` and placed in the same directory.

LOSP Channel Device Drivers

Device directories and files are created under the workstation operating system's `/dev` device directory. All of the following driver directories and files are created regardless of the number of physical channels and hardware devices configured in the MWS-E.

Driver	Description
cv	System level, interrupt-driven driver
ssd	SSD and disk device driver
cvd	Diagnostic driver
cve	Echo driver

Error Logger Devices

A device driver, a directory, and device files are created on the MWS-E during the diagnostic installation procedure. The device directory and files are created under the UNIX system `/dev` device directory. The driver, directory, and files are installed regardless of the physical number of error logger boards actually configured in the MWS. The `/dev/elb` directory contains error logger files `ec00` through `ec07` and `elb0`.

Diagnostic and Maintenance Publications

Refer to the following manuals for CRI system diagnostic and maintenance information:

CRAY Y-MP and CRAY X-MP EA Offline Diagnostic Reference Manual, publication number CDM-1116-0B0.

This manual describes MWS-based tests, single and multiple CPU tests, utilities, and monitors included in the Y1.2 offline diagnostic release.

CRAY C90 Mainframe Offline Diagnostic Manual, publication number CDM-0505-0D0.

This manual provides diagnostic information, including a mainframe maintenance environment (MME) overview, maintenance channel information, control panel information, troubleshooting examples, diagnostic controller information, and MME, simulator, and debugger tutorials.

CRAY Y-MP and X-MP EA Simulator User Guide, publication number CDM-0414-000.

This manual describes how to use the YSIM instruction-level simulator. This guide describes YSIM corresponding to the Y1.2 diagnostic release and version 2.0 of the `cfg` configuration utility. The simulator is a training and troubleshooting tool for teaching CMS commands and CRAY Y-MP diagnostics and hardware.

IOS Model E Offline Diagnostic Reference Manual, publication number CDM-1018-0B0.

This manual describes the theory, commands, and procedures used to run IOS-E offline diagnostics. Revision A incorporates changes to the IOS-E diagnostic set implemented in the ME1.1 diagnostic release. Also added are new DMS commands, a new DMS and YIMS shell environment variable, enhanced DMS diagnostic descriptions, a new DME drive troubleshooting utility description, and new test and utility descriptions. This revision updates the DME menu maintenance utility, YIMS commands, several test descriptions.

System Maintenance Remote Testing Environment (SMARTE) Users Guide, publication number SPM-1017.

This user guide describes how to use the SMARTE window-based online maintenance environment. By using a combination of keystroke entries and menu options, the user can verify CRI system components, detect and isolate errors, and automatically recover faulty hardware components.

SSD-E, SSD-E/32i, and SSD-E/128i Maintenance Systems User Guide, publication number CDM-1019-0B0.

This manual contains user information about the SSD-E, SSD-E/32i, and SSD-E/128i solid-state storage devices.

Displaying Online Diagnostic Listings

Diagnostic listings can be read online under the `mws` login and printed on the OWS-E laser printer. Listing files are created in ASCII or packed text files in the `/cri/mws/lst` directory. Use the following utilities to display online listings:

- `cfpg`
- `ccfpg`

cfpg Utility

The `cfpg` utility creates an xterm window that overlays other windows and displays the specified listing. Examples of typical listing display windows are shown in Figure 4-9 with the commands superimposed on the display windows. Commands and keystrokes (same as `vi` editor) used to maneuver through listings are described in Table 4-1. A listing window can be iconified as shown in Figure 4-8; use the Open (L7) key to redisplay a listing icon.

The `cfpg` utility has the following command format:

```
cfpg  [-c columns] [-f] [-o origin] [-r rows] listing_name
```

Option	Description
`-c`	Defines how many columns long or characters wide for the listing window. Default is 134 columns.
`-f`	Reverse search order. This feature was designed to enable users to display unsupported or outdated listings. Refer to ‘‘Printing Online Diagnostic Listings’’ for more information.
`-o`	Defines the pixel location along the display screen’s left or y axis. The default is 0, which positions the listing window in upper-left corner of the screen.
`-r`	Defines how many rows or lines for the listing window. Default is 32 rows.

Table 4-1. Listing Display Scrolling Commands

Commands/ Keystrokes	Movement
CNTL-D	Down 1/4 screen
CNTL-F	Down 1/2 screen
CNTL-B	Up 1/2 screen
R14, J, or <RETURN>	Down 1 line
R8 or K	Up 1 line
/*string*	Search forward in the file for *string*

Figure 4-8. Diagnostic Listing Icons

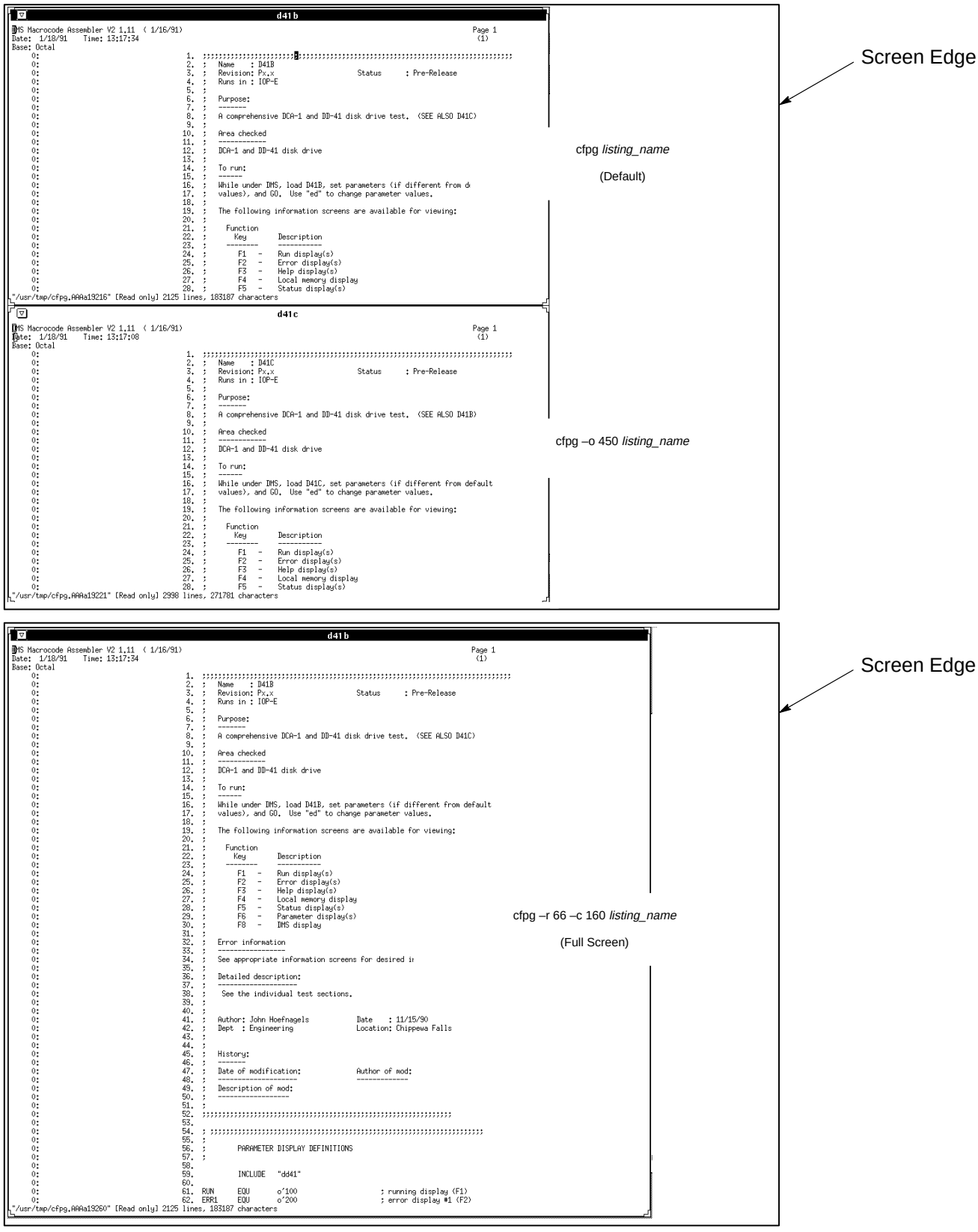


Figure 4-9. cfpg Diagnostic Listing Display Windows

ccfpg Utility

The `ccfpg` command is an alternative to `cfpg` that is used to display diagnostic listings located in the `/cri/mws/lst` directory. This command has the following format:

`ccfpg` ***`testname`***

The `ccfpg` command was written by the Cray Research Engineering department. It is included in the ME release to offer the user another tool to view diagnostic listings. Figure 4-10 shows a listing displayed by the `ccfpg` command. The menu button can also be used to view and search through diagnostic listings.

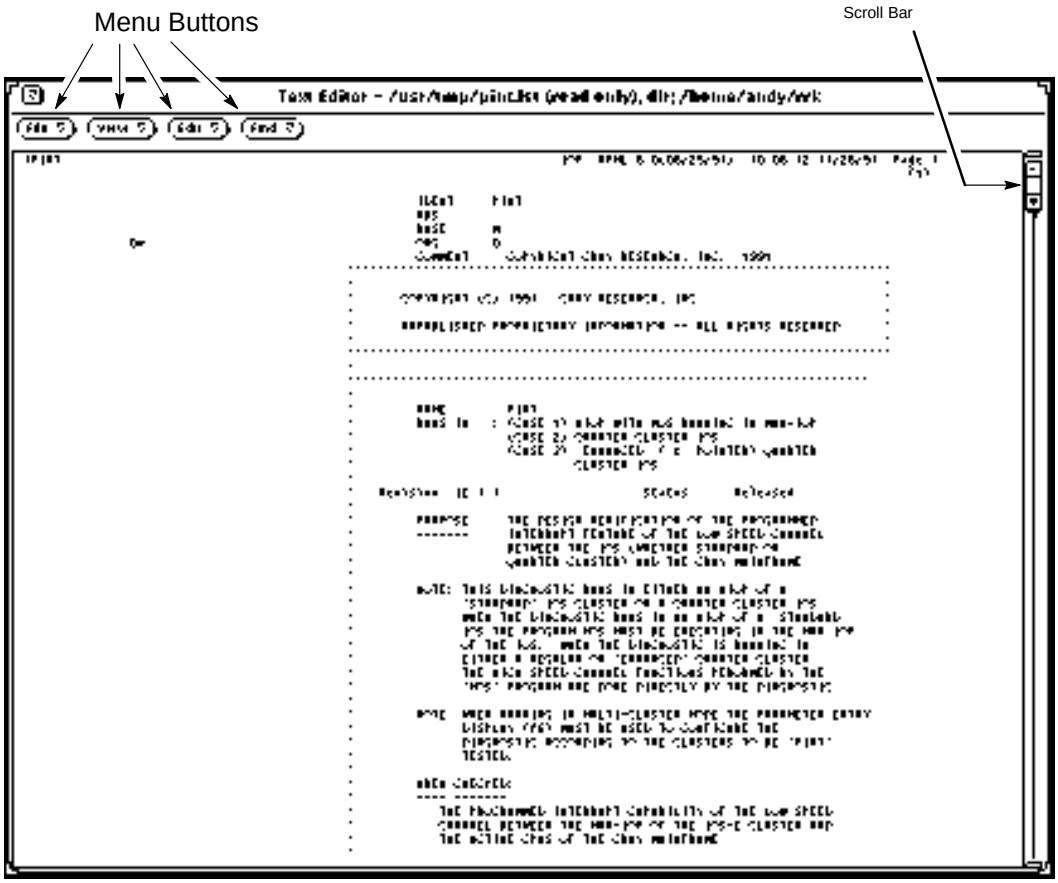


Figure 4-10. ccfpg Diagnostic Listing Display

Printing Online Diagnostic Listings

The `cfl` utility enables the mws login to print diagnostic listings on the OWS-E laser printer; the entire listing is printed if no options are used. This utility prints listings with incrementing page numbers and places a ‘‘CRI Proprietary’’ label on the bottom of each page. The `cfl` utility uses standard input (stdin) if a listing name is not specified.

```
cfl  [-f first_page] [-l last_page] [-r]  listing_name
```

Option	Description
`-f`	First page to print. The default is page 1.
`-l`	Last page to print. The default is the last page.
`-r`	Reverse search order. This option searches for the specified listing name in the current directory before looking in the `/cri/mws/lst` directory. Normally, the `cfl` utility searches for the listing in the `lst` directory with a `.lst.z` suffix (`ypave.lst.z` for example). This feature enables users to print unsupported or outdated listings.

Channel Overview

Figure 4-11 and Figure 4-12 illustrate the channel connections of a CRAY Y-MP system: starting at the MWS-E and connecting to an I/O subsystem model E (IOS-E), a mainframe, and an SSD solid-state storage device model E (SSD-E).

IOS Model E

The IOPs, which include the multiplexer IOP (IOP MUX) and the auxiliary IOPs (EIOPs), control all data transfers into and out of the I/O cluster. The IOP MUX communicates with a mainframe CPU and controls data transfers to or from the mainframe. The four EIOPs control data transfers to or from peripheral devices by controlling the channel adapters and I/O buffers. Each EIOP communicates with the IOP MUX but cannot communicate with other EIOPs or with the mainframe. All five IOPs within a cluster are identical; the physical location of the IOP determines whether it functions as the IOP MUX or as an EIOP.

The low-speed (LOSP) and high-speed (HISP) channel pairs allow the I/O cluster to communicate with the mainframe CPUs. The LOSP channel pair transfers control information between the IOP MUX and the mainframe. One HISP channel pair transfers data between the I/O buffers and the mainframe; the second pair transfers data between the I/O buffers and an SSD. The HISP transfer rate is 200 Mbytes/s. The LOSP transfer rate is 6 Mbytes/s.

The 16 I/O buffers provide temporary storage for data transferred between the mainframe and peripheral devices. Each buffer can transmit data to or from the mainframe while transmitting data to or from a peripheral device. Each buffer is dedicated to one peripheral device, or in the case of mass storage devices, to one group of identical devices.

Channel adapters allow the I/O cluster to communicate with peripheral devices. (Channel adapters operate similarly to peripheral controllers in an IOS-D.) Several types of channel adapters are available, each allowing the I/O cluster to communicate with a different type of device.

Each channel adapter connects to one I/O buffer. During a data transfer from a peripheral device, the channel adapter converts the input data from the device's format to 64-bit words, generates single-error correction/double-error detection (SECDED) bits, and then transmits the converted data and SECDED bits to the I/O buffer. During a data transfer to an external device, the channel adapter receives 64-bit data words (plus SECDED bits) from the I/O buffer, converts the data to the device's format, and then transmits the data to the device. The EIOP controls all the data transfers to the peripheral device through its associated channel adapter.

The cluster interface (CIN) connects the I/O cluster to the two workstation interfaces (WINs). This connection allows the I/O cluster to communicate with the MWS-E and the OWS-E.

The IOS-E contains two WINs regardless of the number of I/O clusters. Each WIN has a LOSP channel pair. One WIN connects to the OWS-E; the second WIN connects to the MWS-E.

MWS-E and OWS-E

Each workstation can send WIN commands that affect the entire IOS, a single I/O cluster, or a single I/O processor. The workstations can master clear the entire IOS, an individual I/O cluster, or an individual I/O processor. Also, the workstations can transfer data to or from any IOP and deadstart an IOP. One workstation monitors the IOPs for errors.

The two WINs operate independently, allowing the MWS-E and OWS-E to simultaneously communicate with the clusters. This feature allows concurrent maintenance. The MWS-E can be used to troubleshoot a specific peripheral device, IOP, or cluster while the OWS-E continues to run under customer control.

SSD Solid-state Storage Device Model E

The SSD-E is similar to the SSD model D, but it has a larger data storage capacity, faster data transfer rates, and new maintenance features. The new SSD is compatible with existing SSD channel connections and system software. All logic functions are implemented using 2500-gate array circuits.

Each SSD-E port has its own path to and from each section of available memory. Control and address information is sent to the control board, which sends the information to each memory section. This eliminates signal fanouts between sections and makes isolating data failures easier.

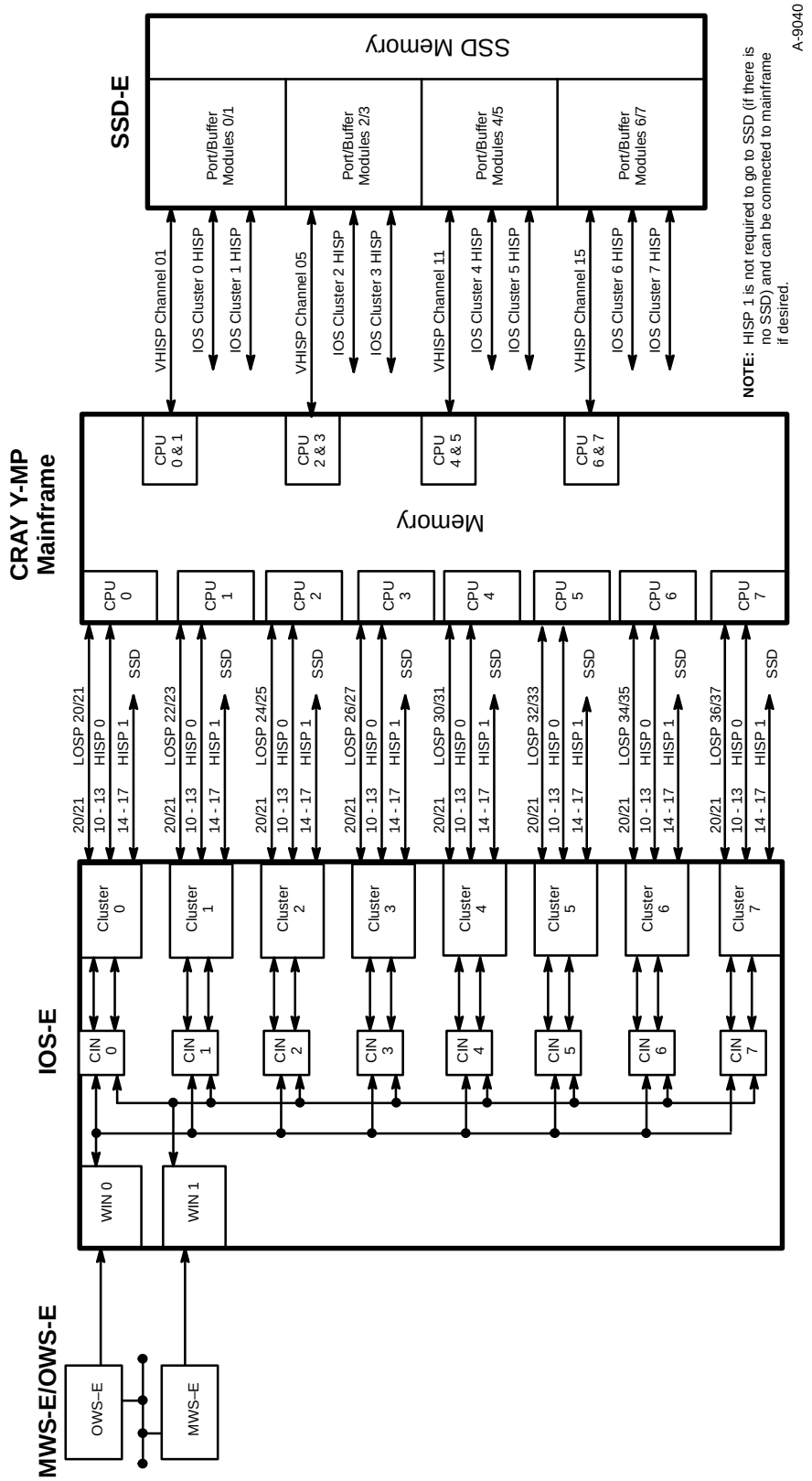


Figure 4-11. System Channel Overview

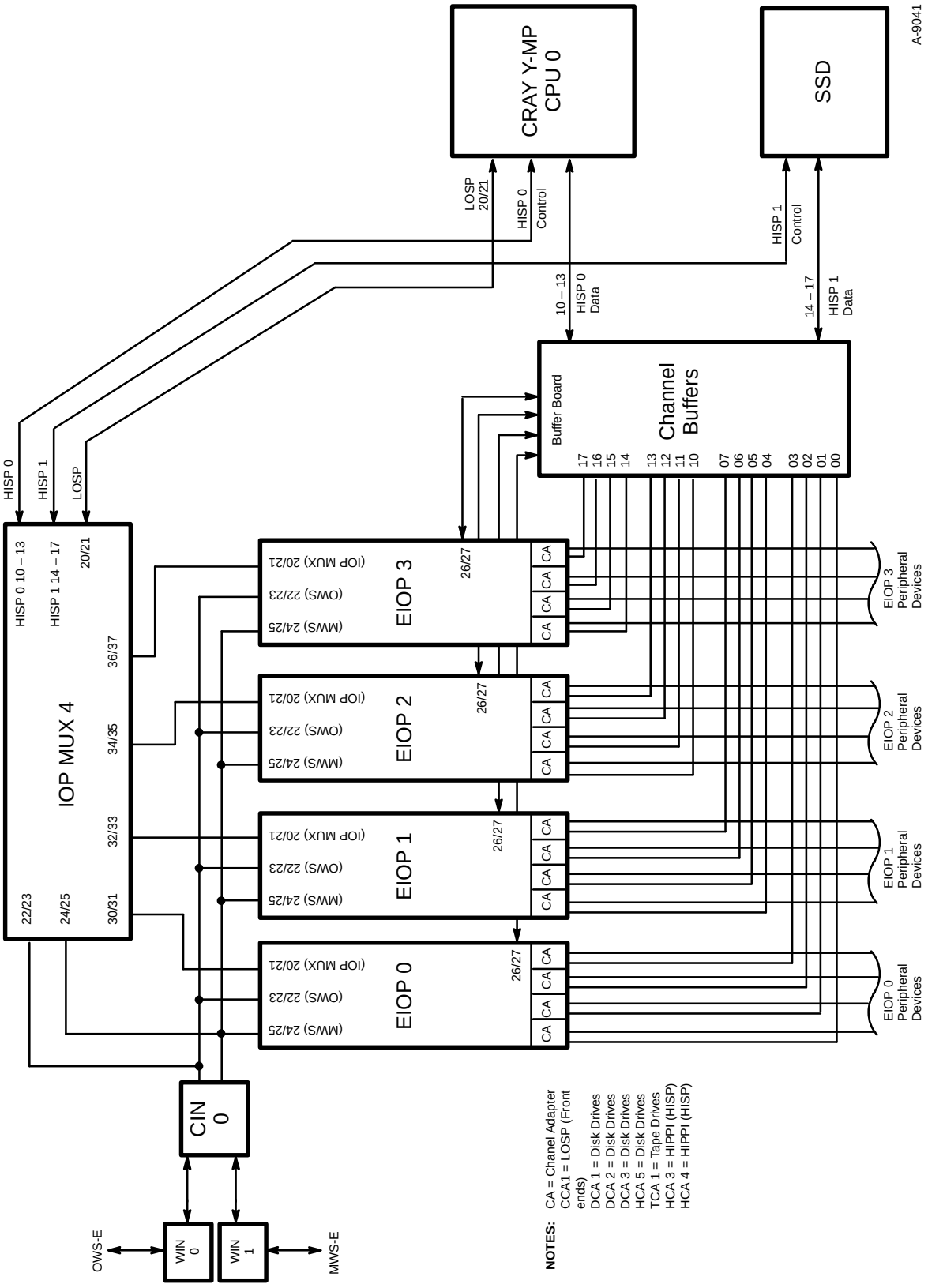


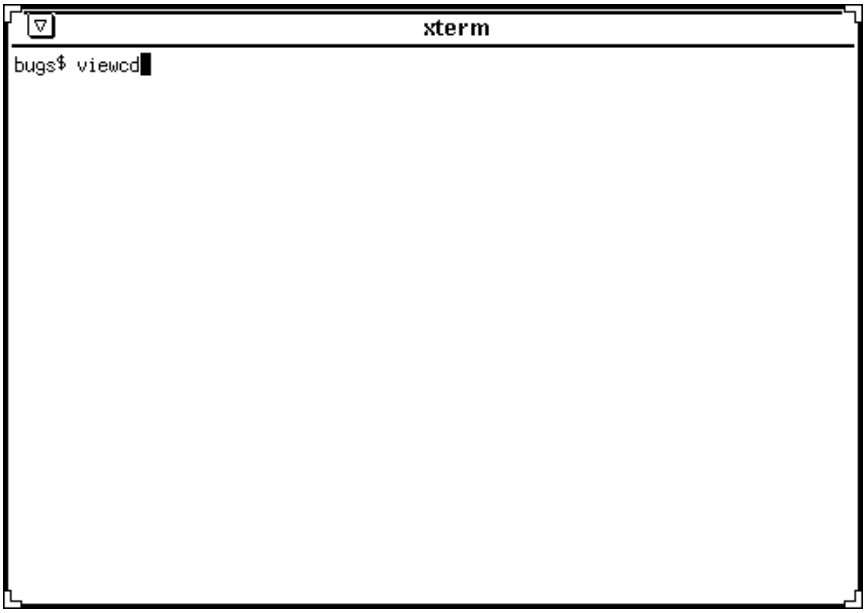
Figure 4-12. Cluster 0 Channel Connections

Using viewcd

The `viewcd` utility is software that allows the user to access documents recorded on a compact disk read-only memory (CD-ROM).

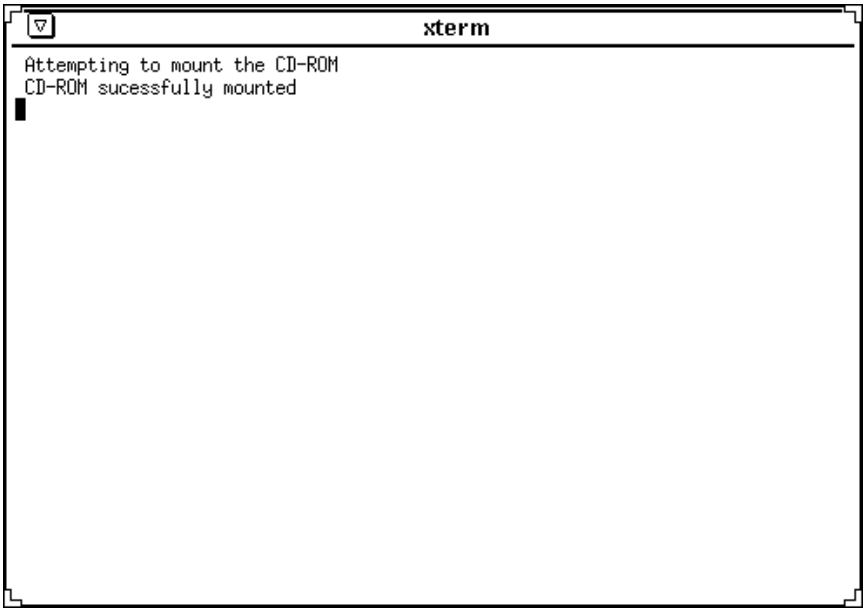
In the following example, each numbered step has a companion `xterm` window display that illustrates and supplements the text.

1. Start `viewcd` by entering **`viewcd`** in an `xterm` window.

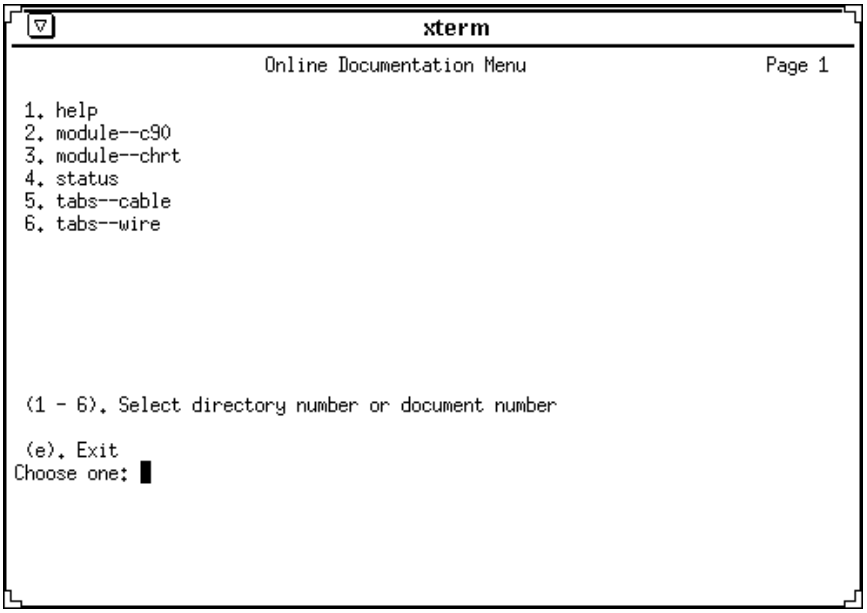


2. A display appears that indicates the CD-ROM is being mounted.

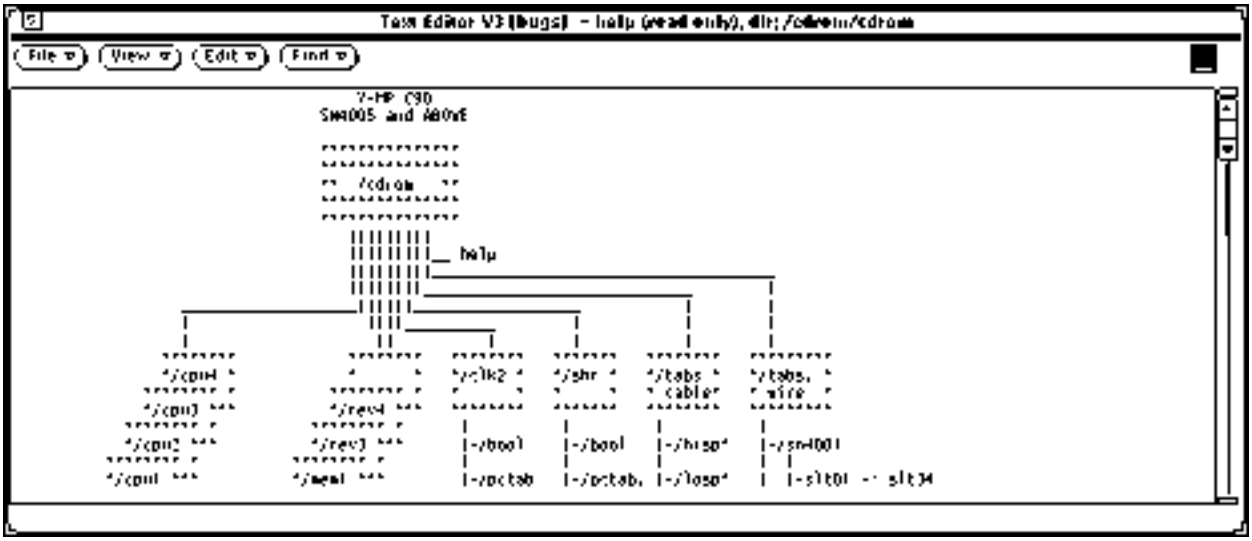
   When the CD-ROM is ready to use, you are notified with a status message.



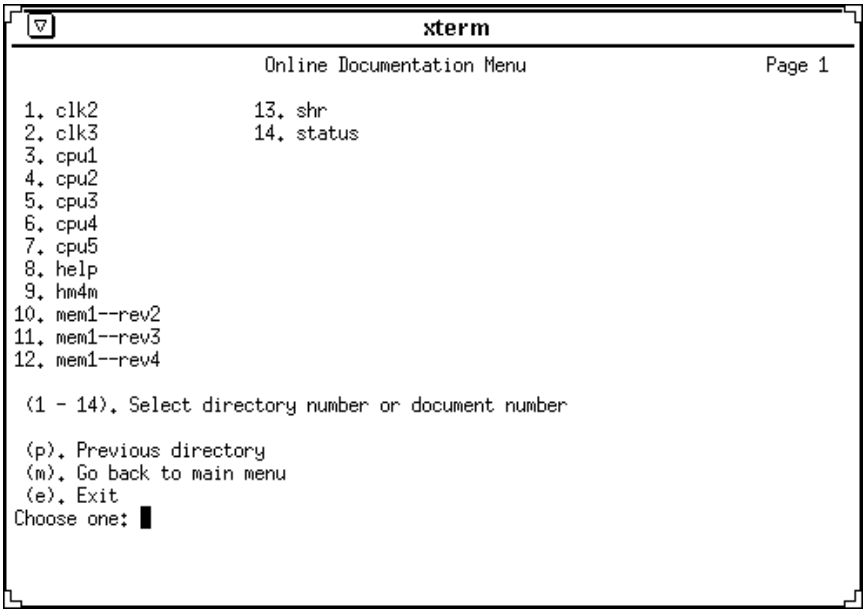
3. The main menu appears automatically and displays the contents of your CD-ROM. To continue this example, enter **1**, the `help` selection.



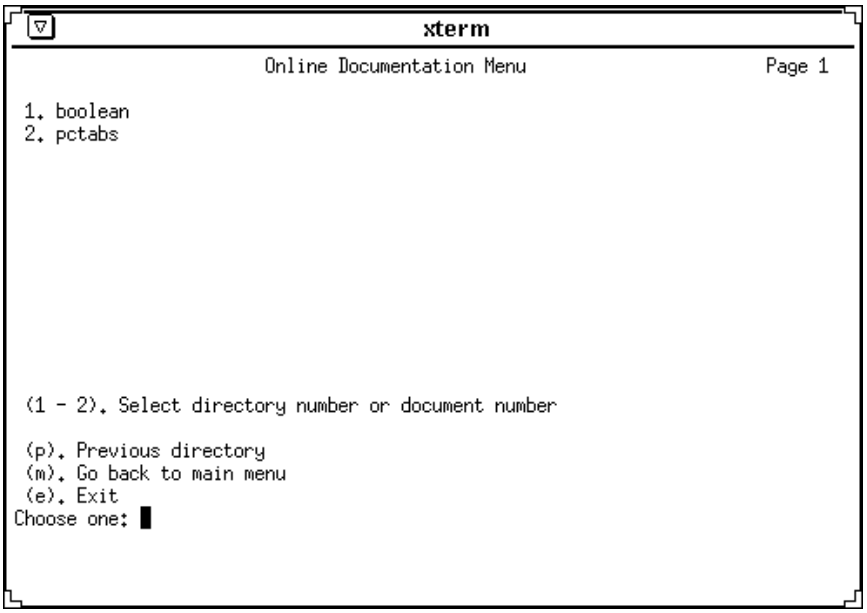
4. In a few seconds, a `Text Editor` window opens and displays the contents of the `help` file. Normal Text Editor commands are applicable. (The `xterm` window that contains the menu remains available, allowing you to create multiple `Text Editor` windows if you wish.) `Text Editor` windows remain open until the end of the session unless you close them.



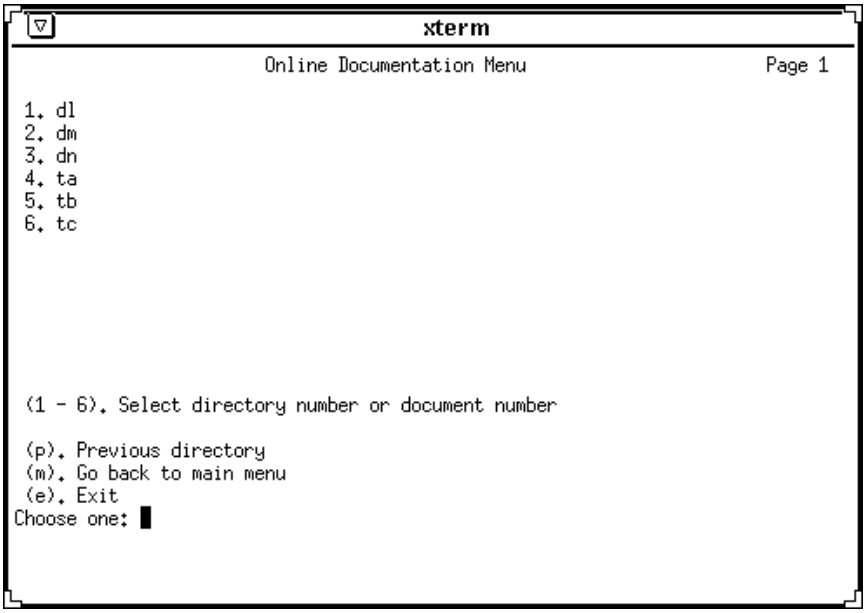
5. The menu structure in `viewcd` is hierarchical. If you had entered `2` at the main menu in Step 3, the second-level menu shown below would have appeared, offering 14 CRAY C90 module choices. The following display screen defines program navigation options `p`, `m`, and `e`. To continue, enter **`1`**.



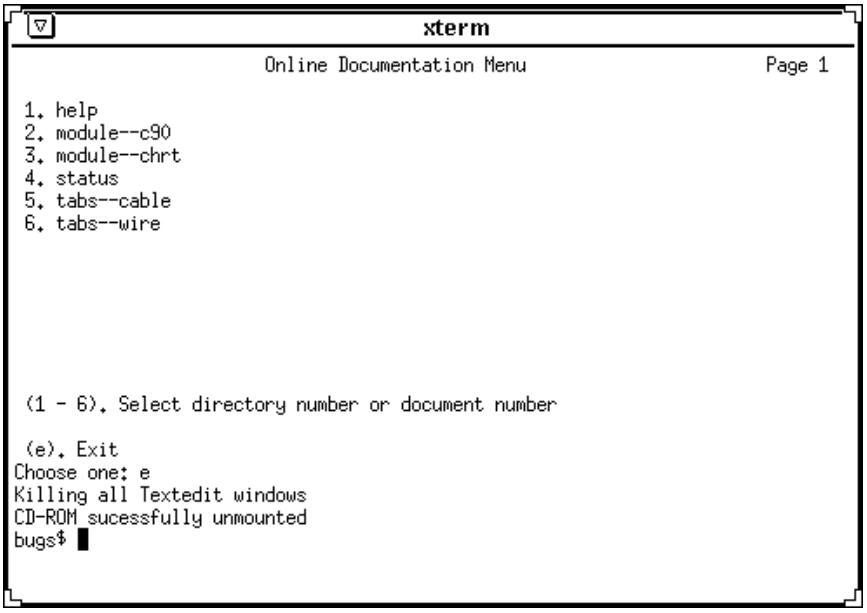
6. Entering `1` in the previous step results in a third-level menu that offers you a choice of viewing the `clk2` selection in either Boolean or wiretab format. Enter **`1`** again to select `boolean`.



7. A fourth-level menu appears. After you have selected one of the six choices (modules) from the fourth-level menu shown below, a `Text Editor` window appears (not shown here) that displays the dl module Boolean you requested.



8. Finally, when you are ready to end the session, enter **e**. The `viewcd` utility automatically closes any `Text Editor` windows that are open, unmounts the CD-ROM, and returns to the system prompt.



5 SYSTEM ADMINISTRATION

This section outlines the essential information and procedures used to monitor, configure, back up, and perform system administration on the MWS-E.

Process Monitoring

To monitor processes on the MWS-E, use the `ps` command with the options `a`, `u`, and `x`.

Table 5-1. ps Command Options

Option	Description
`-a`	Show processes owned by others
`-u`	User-oriented output headers
`-x`	Include processes with no controlling terminal

```
mws1234$ ps -aux
USER       PID %CPU %MEM   SZ  RSS TT STAT START  TIME COMMAND
mws        171 44.2  4.0   72  592 p0 R N  11:59  18:59 xlock
root       177  7.7  3.3  192  480 p5 R    12:35   0:00 ps -aux
root       172  5.0  2.4   64  352 ?  S    12:35   0:01 in.telnetd
root       173  1.0  3.0   80  448 p5 S    12:35   0:00 -csh (csh)
root        60  0.0  0.0   56    0 ?  IW   11:58   0:00 keyserv
root        71  0.0  0.0   24    0 ?  I    11:58   0:00  (biod)
root        72  0.0  0.0   24    0 ?  I    11:58   0:00  (biod)
root        73  0.0  0.0   24    0 ?  I    11:58   0:00  (biod)
root        74  0.0  0.0   24    0 ?  I    11:58   0:00  (biod)
root        85  0.0  0.5   72   80 ?  S    11:58   0:00 syslogd
root       114  0.0  0.0   64    0 ?  IW   11:58   0:00 cron
root       111  0.0  0.1   24   16 ?  S    11:58   0:03 update
root        98  0.0  0.0   56    0 ?  IW   11:58   0:00 rpc.statd
root        99  0.0  0.0   88    0 ?  IW   11:58   0:01 rpc.lockd
```

Monitoring Users

You can use the `w` command to summarize the activities of all users on the MWS-E as shown in the following screen.

```
mws1234: w
 10:19am  up 11 days, 22:49,  7 users,  load average: 1.00, 1.00, 1.00
User     tty       login@  idle   JCPU   PCPU  what
mws      console  Mon12am 3days 199:53  91:27  /usr/openwin/demo/xterm
mws      ttyp0    11:33pm  2:01     17         sh
mws      ttyp1    Mon12am         4:38   4:35  sh
mws      ttyp2    Mon12am  2:02   9:14      1  sh
mws      ttyp3     1:57am  2:13   4:22         sh
mws      ttyp4     7:49am  2:30                /bin/sh
mws      ttyp5     7:49am  2:05     10     10  sh
ctp      ttyp6    10:19am                     w
```

The **`last`** command can be used to display who is logged on the system and who has already logged off. The **`last`** command is usually used with a number argument to specify the number of users to display. The first example shows users that have logged in from remote hosts; notice that the remote host name is shown in the output. The second example displays users that have logged in from the console.

```
mws1234: last -7
ctp       ttyp6    panzer           Thu Nov  5 10:19   still logged in
mws       ttyp6    sawdust          Thu Nov  5 08:46 - 08:53  (00:06)
mws       ttyp5    potiron          Thu Nov  5 06:26 - 06:34  (00:07)
mws       ttyp6    delta.crj        Wed Nov  4 20:02 - 20:06  (00:03)
mws       ttyp7    techops          Wed Nov  4 15:23 - 15:33  (00:09)
mws       ttyp7    dasher           Wed Nov  4 14:36 - 14:58  (00:22)
mws       ttyp7    andy             Wed Nov  4 10:33 - 10:34  (00:00)
```

```
mws1234: last -9 console
mws       console                  Mon Nov  2 00:16   still logged in
mws       console                  Mon Oct 26 07:01 - 16:34 (4+09:32)
root      console                  Mon Oct 26 06:11 - 06:13  (00:01)
djd       console                  Mon Oct 26 06:09 - 06:11  (00:01)
mws       console                  Fri Oct 23 08:10 - 14:40  (06:30)
mws       console                  Fri Oct 23 01:28 - 08:09  (06:41)
mws       console                  Fri Oct 23 01:28 - 01:28  (00:00)
mws       console                  Thu Oct 22 07:58 - 01:27  (17:29)
mws       console                  Thu Oct 22 00:53 - 07:39  (06:46)
```

Monitoring Disk Space

The `df` and `du` commands can be used to monitor disk space and to verify that file systems are not exceeding established capacities. The `df` command displays the amount of disk space that can still be used (`avail`). The `df` command should also be used prior to making backup tapes (`dump`); this enables the administrator to spot unusually large file systems before starting the backup process.

```
mws1234: df
Filesystem            kbytes    used   avail capacity  Mounted on
/dev/sd0a              14983    5587    7897    41%    /
/dev/sd0d             138608  115031    9716    92%    /usr
/dev/sd0h             261423  101302  133978    43%    /cri
/dev/sd0g               4848    1686    2677    39%    /home
/dev/sd0f             138608    1756  122991     1%    /var
```

The `du` command displays the number of kilobytes of disk space used in all files including all subdirectories and the files they contain. The `du` command can be used to quickly locate large files within a file system. If a filename argument is not supplied, `du` uses the current directory.

```
mws1234: du /var/adm
4       /var/adm/acct/nite
1       /var/adm/acct/fiscal
1       /var/adm/acct/sum
7       /var/adm/acct
4       /var/adm/sundiaglog
353     /var/adm
```

Log Files

There are several files in the `/var/adm` directory on the MWS-E that need to be monitored. These files grow continuously and could take up large amounts of disk space.

- `/var/adm/wtmp`
- `/var/adm/lastlog`
- `/var/adm/messages.`*x*

The `wtmp` file is a data file that is used to record all logins and logouts. The `lastlog` file records the most recent login date for every user. The `messages.`*x* file contains system messages that are displayed in

the console window or on the screen. Do not delete these files with the remove (`rm`) command. Copy the `/dev/null` file over the existing files with the copy (`cp`) command:

```
mws1234: cp /dev/null /var/adm/lastlog
overwrite tester? y
mws1234:
```

Hard Disk File Partitions

Table 5-2 lists and describes the hard disk file partitions as configured when installing the model E maintenance diagnostic (ME) release.

Table 5-2. MWS-E Hard Disk Drive File Partitions

Partition Name	Partition Letter	Mounted File System	Size in Mbytes	Description
root	a	/	15	Root is the top of the directory tree; it contains machine-specific files and directories crucial for system operation. Root contains vmunix (the operating system kernel), the /dev device directory for all devices in the system, and programs for booting the system.
swap	b		58	Swap is used by the operating system to store active programs while they are not actually being executed to open memory space for other programs. The UNIX kernel (vmunix) also uses the swap area for temporarily storing files used in the boot/startup sequence.
disk	c		668	Disk contains all file systems on the disk.
usr	d	/usr	216	Usr is a general purpose directory containing operating system commands, utilities, and administrative files.
export	e		0	Export is used on SunOS systems configured as file servers. The export partition is used to network directories and files to client machines. The export partition is not used on the MWS-E.
var	f	/var	135	Var contains administrative log files, mail, and spool files, all of which tend to grow or vary in size. Since these files change frequently, the /var partition should be backed up weekly.
home	g	/home	20	Home is a small partition provided for nonproprietary files or logins.
cri	h	/cri	220	Cri contains all CRI proprietary maintenance software including the mws maintenance login.

The hard disk is organized into partitions; each partition has a primary use, and each partition corresponds to a device with the following format for SCSI devices:

```
/dev/rsx#z
```

Option	Description
r	Raw; means the device does not buffer.
sx	SCSI controller type: disk (sd), tape (st), and CD-ROM(sr).
#	Disk device number.
z	Letter of the partition (a, b, d, f, g, or h).

For example, when backing up the home (g) file partition on the SCSI hard disk drive, you would specify the `/dev/rsd0g` file.

Backup Procedures

It is very important that you or the person administering the MWS-E and/or OWS-E regularly back up the file systems. You may need to rely on the latest backup tape in the event of a system crash or accidental deletion of some files.

Sun Microsystems, Inc.'s *System & Network Administration* manual provides detailed descriptions on backing up and restoring file systems. There are several methods and many options that can be used to perform backups. For the sake of simplicity and consistency, you should follow the backup procedures described in this section.

Perform the following types of tape backup procedures:

- Full file system backups-monthly
- Incremental backups-weekly

Incremental backups copy only files modified since the last dump procedure.

Use the following utilities to create backup tapes and retrieve files from backup tapes:

dump Allows full and incremental backups on a per-file-system basis by using a range of levels from 0 to 9. Each time dump is used to back up files, it enters a record of the backup in the `/etc/dumpdates` file.

restore Restores files from backup tapes made with the `dump` command.

tar Performs backups on a file-by-file basis. The tape archive (`tar`) command is *not* recommended for regular backups. The only time you may need to use the `tar` command is to retrieve files from tape that were archived in `tar` format or to copy files that you want to transfer to another machine.

mt The magnetic tape control (`mt`) command is used to send tape positioning and control signals to tape drives.

cpio This command copies files into and out of `cpio` archived tapes. If you receive a tape whose files were written using `cpio`, use the following command to read all files from the tape:

```
cpio –icvBdu < /dev/rst0
```

Recommended Streaming Tapes

To ensure quality streaming tape recordings, use high-density tapes with a rating of 12,500 FPTI. Lower-rated tapes and tapes of lesser quality give inconsistent results and may not always be readable. We recommend that you order DC 6150 620-ft streaming tapes (P/N 01389801) from Logistics.

Unreadable Streaming Tapes and Compact Discs

Refer to the following troubleshooting steps if you have any trouble reading a streaming tape or compact disc from the MWS-E:

Streaming Tapes

1. Tape reading problems are often the result of slack or improper tension in the tape. Enter the following command to retension the tape and then try to read the tape a second time:

```
mws1234# mt -f /dev/rst0 retension
```

2. If the `retension` command did not help, clean the tape head and try to read the tape. Refer to Section 4, "Preventive Maintenance," in the *MWS-E and OWS-E Hardware Maintenance Manual* for instructions on cleaning the streaming tape drive head.

3. If you cannot read the tape after trying the previous steps, telephone for a replacement tape. Telephone numbers for replacement ME offline diagnostic tapes are provided in the appropriate release announcement.

4. Save and return the tape to the appropriate Cray Research, Inc. department. The tape will be analyzed to determine why you could not read it.

Compact Discs

1. If you have problems reading a CD, eject and clean the CD and try to read it a second time.

2. Determine if the CD-ROM player is working by inserting and reading or playing a different CD. If you cannot read another CD, run the SunDiag CD tests as described in "SunDiag Diagnostic Testing System" in Section 3 of the *MWS-E and OWS-E Hardware Maintenance Manual*.

3. If you can read a different CD, the disc you could not read is probably damaged. Order a replacement CD.

   Be sure to return the CD to the appropriate department for analysis. Be sure to indicate the correct part number when ordering a replacement CD.

CD-ROM Error Messages

The CD-ROM driver may not be able to read a defective disc. When this occurs, the `eject` command may also fail and display the following error message. If you receive this message, press the eject button on the CD-ROM player to manually eject the CD.

```
mws1234# eject cdrom
eject: Open fail on cd –> /dev/rsr0: I/O error
```

The following messages may appear in the console window when you are trying to mount a CD. These messages can be ignored.

```
sr0a: read recoverable, block 198000
sense key (0x1): soft error, error code (0x18):
soft data error
```

Full Backup Procedure

Use the following procedure to make a full file system backup tape for each file partition. This procedure uses a cartridge tape for each file partition backup. Although some file partitions use less than half the tape capacity, this method is the easiest and most convenient means of retrieving files.

1. Log out of the **mws** login environment.
2. Log in to the system as **root**.
3. Shut down the operating system and bring the system to single-user mode by entering this command:

```
mws1234# shutdown now
```

After the `shutdown` process is completed, the single-user mode prompt (without the mws serial number) should appear.

4. Check the file system and make any needed repairs by entering the following file system check command. This step helps ensure a clean file system backup.

```
# fsck
```

The following information is displayed for each of the file systems:

```
** /dev/rsd0a
** Currently mounted on /
** Phase 1 – Check Blocks and Sizes
** Phase 2 – Check Pathnames
** Phase 3 – Check Connectivity
** Phase 4 – Check Reference Counts
** Phase 5 – Check Cyl groups
10088 files, 106667 used, 31941 free (237 frags, 3963 blocks, 0.2 fragmentations)
```

5. Display the size of each file system in Kbytes by entering the disk free (`df`) command as shown in the following screen:

```
# df
Filesystem           kbytes   used   avail capacity   Mounted on
/dev/sd0a             14983    7201    6283    53%    /
/dev/sd0d            138608  111979   12768    90%    /usr
/dev/sd0h            261423   46259  189021    20%    /cri
/dev/sd0g              4848    1466    2897    34%    /home
/dev/sd0f            138608   84586   40161    68%    /var
```

The size of each file system is indicated under the `used` column. This information can be used to determine if more than one tape is needed to `dump` a particular file system (the `dump` command prompts the user if a second tape cartridge is needed).

6. Insert a blank tape that is not write-protected into the tape drive. Enter the following command if you need to rewind the tape:

```
# mt –f /dev/rst0 rewind
```

Hint: You can create or set an environment variable (`setenv`) called `TAPE` and make it equal to `/dev/rst0`. By doing this you can then enter the `mt rewind` command, which will be equal to the above `mt –f /dev/rst0 rewind` command. Add the following line to your `.cshrc` file:

```
setenv TAPE /dev/rst0
```

7. Copy each file partition to a separate tape by entering the following command [replace `<letter>` with the appropriate file partition letter (`a`, `d`, `h`, `g`, or `f`); *do not* back up file partitions `b` or `c`]:

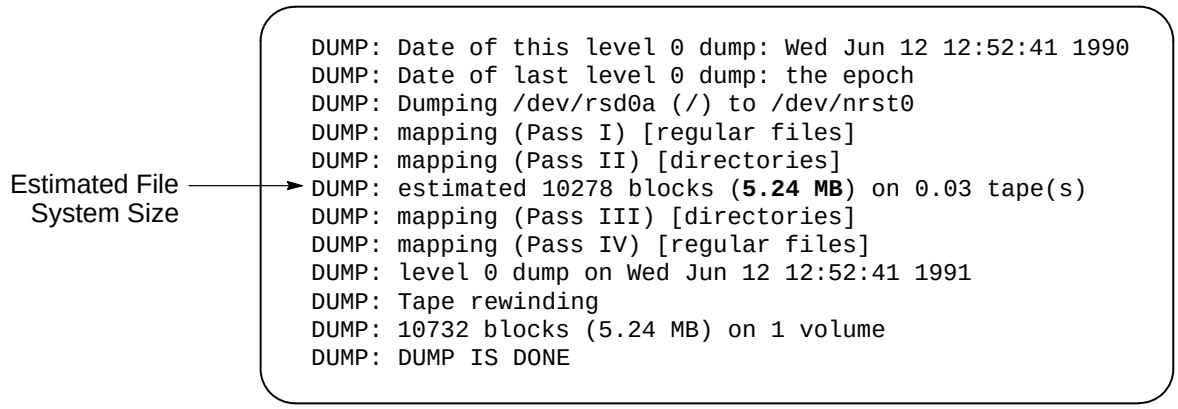
```
# dump 0ucdsf 2500 600 /dev/rst0 /dev/rsd0<letter>
```

Option	Description
`0`	Dump level 0 (zero) – copies the entire file system.
`u`	Update – logs the dump level, date and file partition to the `/etc/dumpdates` file.
`c`	Cartridge tape – includes defaults of 1000-bpi tape density, 126 blocking factor, 9 tracks, and 450-ft tape length.
`d`	Density – 2,500 bpi.
`s`	Size (length) – A length of 600 ft is specified for a 620-ft tape to provide an overflow margin.
`f`	File – specifies output device name.

Hint: You can substitute the file system name for the `/dev` file partition. For example, you substitute the `/usr` name for the `/dev/rsd0d` partition. It is easier to remember the file system name than the partition letter, and it also requires less typing.

NOTE: The `dump` program uses the density and size options for estimating how much tape it needs to back up the file system. The size estimated, as shown in the following `dump` message screen, should be slightly more than the actual file system size to ensure that all data fits on a tape. This is not a critical factor unless you are backing up a file system that is near to or larger than the 150-Mbyte capacity of streaming tapes.

Messages similar to those in the following screen are displayed for each file partition `dump` session:



8. After the file system `dump` is complete, remove the tape from the drive and record the file partition, `/dev` name, `dump` level, and date on the tape label. Turn the write-protect plug to the SAFE position and store the tape with the rest of your backup tapes.

9. Repeat Step 7 and 8 for each file system.

10. After backing up all file systems, return the system to multi-user mode by entering the **`CNTL-D`** command.

    Normally you would use the `reboot` command to reboot the system; however, the `CNTL-D` command may be used in this situation because the system is in single-user mode and the hard drive was inactive during the `dump` session.

Backup Schedules

Incremental backups of the file system partition can be made in between full backups to save time. Incremental backups are usually made on a weekly basis. Using a higher level dump (9 in the following procedure) requires less time because only files that have changed since the last lower level `dump` (0-8) are backed up. When making incremental backups, the dump utility reads the `/etc/dumpdates` file to determine prior `dump` dates.

Two weekly incremental backup tapes made at the same level contain all files changed since a lower level or full backup tape was made, as shown in the following monthly backup schedule:

Weekend Backups	Dump Level	Files Changed During the Week	Tape Contents
Week 1	0		All files
Week 2	9	file1	file1
Week 3	9	file2	file1 and file2
Week 4	9	no changes	file1 and file2

You could create an elaborate backup schedule with different `dump` levels, but this could become very complicated; and, recovering a large directory or entire file system partition could become difficult. Refer to the Sun Microsystems, Inc. *System & Network Administration* manual for complete backup information.

The following `dump` schedule is suggested to provide fast and simple backups and file recoveries:

Table 5-3. Suggested Backup Schedule

File System	Frequency
root (/)	Monthly – level 0
/usr	Monthly – level 0
/var	Monthly – level 0
/home	Beginning of month – level 0 and Weeks during the month – level 9
/cri	Beginning of month – level 0 and Weeks during the month – level 9

Incremental Backup Procedure

Use the following procedure to perform a partial file system backup:

1. Follow Steps 1 through 6 in the ‘‘Full Backup Procedure’’ subsection.

2. Make an incremental backup to tape by entering the following command:

```
# dump 9ucdsf 2500 600 /dev/rst0 /dev/rsd0<letter>
```

   The `9` option copies only the files in the partition that have changed since the last lower level dump as listed in the `/etc/dumpdates` file.

3. After the file system dump is complete, remove the tape from the drive and record the file partition, `/dev` name, `dump` level, and date on the tape label. Turn the write-protect plug to the SAFE position and store the tape with the rest of your backup tapes.

4. After making all incremental backup tapes, return the system to multi-user mode by entering the **`CNTL-D`** command.

Recovering Lost or Damaged Files

It may be necessary to occasionally restore lost or damaged files. Files could be lost for any of the following reasons:

- Accidental removal by a user
- File corruption from disk error
- Hard disk failure resulting in operating system corruption

Individual files or groups of files can be restored if backup tapes were made. Changes made to files since the last backup will be lost.

The `restore` command is used to recover files from backup tapes created with the `dump` command.

Restoring a File

The following procedure describes how to restore a lost file:

1. Load the backup tape that contains the file to be restored.

2. Log on the system as **root** or use the **su** command to gain root privileges.

3. Use the **cd** command to change to the directory under which the file system backup was made (/, /usr, /var, /home, or /cri). You should be in one of these directories to ensure that the file(s) to be restored are placed in the proper directory. Restored files are placed relative to the directory in which you are operating.

4. Check to see whether the file exists on the backup tape by entering the following command (this may take 1 or 2 minutes):

   The *filename* must be the complete pathname of the file relative to the file system directory. For example, if you are restoring a file called /cri/mws/file1, you should enter **./mws/file1** as the *filename*.

```
mws1234# restore tf /dev/rst0 filename
```

   Hint: Enter the above command without specifying a file name to list all files on the tape. Enter the command with a directory name to list all files in a directory. This is a quick way to check whether several files are on a tape or whether a directory that needs to be restored exists on the tape.

5. Restore the file by entering the following command:

```
restore xf /dev/rst0 filename
```

   The following warning message and instruction prompts are displayed; don't be alarmed by the message; it indicates that the parent directory of *filename* exists on the disk.

```
Warning: ./directory: File exists
You have not read any volumes yet.
Unless you know which volume your file(s) are on you should start
with the last volume and work towards the first.
Specify next volume #: 1
set owner/mode for '.'? [yn] y
```

6. Enter **1** to specify the volume number and enter **y** to set the owner mode.

7. Check to see if the files are restored to the desired location.

8. Remove the backup tape and store the tape with the rest of your backup tapes.

Restoring Files in Interactive Mode

This procedure describes how to recover one or more files using the restore command in interactive mode.

1. Load the backup tape that contains the file to be restored.

2. Log on the system as **root** or use the **su** command to gain root privileges.

3. Use the **cd** command to change to the directory under which the file system backup was made (/, /usr, /var, /home, or /cri). You should be in one of these directories to ensure that the files to be restored are placed in the proper directory. Restored files are placed relative to the directory in which you are operating.

4. Enter the following command to start the interactive mode of the restore command:

```
mws1234# restore ivf /dev/rst0
```

The information in the following screen is displayed:

```
Verify volume and initialization maps
Media block size is 126
Dump  date : Wed Jun 12 12:52:41
Dumped from: the epoch
Level 0 dump of / on mws1234:/dev/rsd0a
Label: None
Extract directories from tape
Initialize symbol table.
restore>
```

5. Enter the list (**ls**) command from the restore prompt to list files in the current directory:

```
restore> ls
```

6. Enter the change directory (**cd**) command if you need to move to another directory:

```
restore> cd
```

7. After you locate the files or directory that you need to restore, use the **add** command to add files to the extraction list (a list of files that you want to restore).

   You can add several files to the list; use the **add** command for each file. An asterisk is placed next to each file added to the list.

```
restore> add filename
Warning: ./directory_name: File exists
```

Don't be alarmed by the warning message; it indicates that the parent directory of *filename* exists on disk.

The following message indicates that the parent directory of *filename* was not found and that the `restore` command will create a new directory relative to the directory you are currently in. (This message usually indicates that you did not change the directory to the correct file partition directory.)

```
Make node ./directory_name
```

The **delete** command is used to remove any files accidentally added to the extraction list.

8. Enter the following command to restore all files added to the extraction list:

```
restore> extract
```

9. Reply to the messages displayed as shown in the following screen display:

```
Extract requested files
You have not read any volumes yet
Unless you know which volume your file(s) are on you should start
with the last volume and work towards the first.
Specify next volume#: 1
extract file ./directory_name/filename
Add links
Set owner/mode for '.'[yn] y
```

10. Enter the following command to exit interactive mode:

```
restore> quit
```

11. Check to see whether your files have been restored. Restored files show the date that the backup tape was created as labeled in the `/etc/dumpdates` file.

Restoring an Entire File System Partition

Two procedures are provided describing how to restore an entire file system partition:

- Restoring the `/cri`, `/home`, or `/var` file systems
- Restoring the `/` (root) or `/usr` file systems

Restoring the /cri, /home, or /var File Systems

Do not use this procedure for restoring the `/` (root) or `/usr` file systems; these file systems require a different procedure because the programs needed for the recovery process are located in the `/` and `/usr` file systems.

1. Log on the system as **`root`** or use the **`su`** command to gain root privileges.

2. Shut down the operating system and bring the system to single-user mode by entering this command:

```
mws1234# shutdown now
```

3. Enter the following command to unmount the file system that needs to be restored:

```
# umount /dev/sd0<letter>
```

4. Create a new file system by entering the following command:

```
# newfs /dev/rsd0<letter>
```

5. Run the file system check (`fsck`) utility on the new file system by entering the following command:

```
# fsck /dev/rsd0<letter>
```

6. Mount the file system by entering the following command:

```
# mount /dev/sd0<letter> /file system name
```

7. Move to the new file system directory by entering the following command:

```
# cd /file system name
```

8. Load the dump level 0 backup tape that contains the file system to be restored.

9. Restore the entire file system from tape by entering the following command (a long list of files and directories nodes are created, and the files are extracted):

```
# restore rvf /dev/rst0
```

10. Enter the following command to remove the `restoresymtable` file:

```
# rm restoresymtable
```

11. Move to the root directory by entering the following command:

```
# cd /
```

12. Enter the following command to run the file system check utility on the restored file system:

```
# fsck /dev/sd0<letter>
```

13. Back up the restored file system on the same tape that you used to restore the file system (make sure the tape is write enabled):

```
# dump 0ucdsf 2500 600 /dev/rst0 /dev/rsd0<letter>
```

14. Enter the following command to move to monitor mode:

```
# shutdown –h now
```

15. Enter the following command to reboot the system:

```
>b sd()
```

Restoring the / (root) or /usr File Systems

The following procedure describes how to restore the /(root) or /usr file systems. These file systems must be recovered from the SunOS CD-ROM supplied with the ME diagnostic release.

1. Log in to the system as **root** or use the **su** command to gain root privileges.

2. Shut down the operating system and bring the system to monitor mode by entering:

```
mws1234# shutdown –h now
```

3. Load the SunOS CD-ROM.

4. Enter the following command to boot from the CD-ROM:

```
>b sd(,30,1) –sw
```

The following prompt appears:

```
What would you like to do?
  1– Install SunOS mini–root
  2– exit to single user shell
Enter a 1 or 2: 1
```

5. Enter **1** to install the SunOS miniroot. The following prompt appears.

```
Do you want to format and/or label disk ‘‘sd0’’?
  1– yes, run format
  2– no, continue with loading miniroot
  3– no, exit to single user shell
Enter a 1, 2, or 3: 2
```

6. Enter **2** to continue loading miniroot. The following prompt appears:

```
Mini–root installation complete.

What would you like to do?
  1 – reboot using just–installed miniroot
  2 – exit into single user shell
Enter a 1 or 2: 1
```

7. Enter **1** to reboot using the new miniroot.

   The system reboots and returns to the root login single-user mode prompt (#).

8. Enter the following command to recreate the `root` file system (`root` is letter **a** and `/usr` is letter **d**):

```
# newfs /dev/rsd0<letter>
```

9. Check the file system by entering the following command:

```
# fsck /dev/rsd0<letter>
```

10. Enter the following commands to make a `mount` directory and to `mount` the new file system:

```
# mkdir /mnt
# mount /dev/sd0<letter> /mnt
```

11. Move to the `/mnt` directory and extract the files and directories from the backup tape by entering the following commands. Make sure you have the correct backup tape installed.

```
# cd /mnt
# restore rvf /dev/rst0
```

12. Remove the `restoresymtable` file that is created by the `restore` command by entering the following command:

```
# rm /mnt/restoresymtable
```

13. *This step should be used only when restoring the / (root) partition. If restoring the /etc partition, go to Step 14.*

    Create a new boot block by entering the following commands:

```
# cd /usr/mdec
# installboot /mnt/boot bootsd /dev/rsd0a
```

14. Unmount and check the file system by entering the following commands:

```
# cd /
# umount /dev/sd0<letter>
# fsck /dev/rsd0<letter>
```

15. The file system is now restored. Perform the remaining steps after you reboot the system.

16. Create a level 0 backup of the newly restored file system:

```
# dump 0ucdsf 2500 600 /dev/rst0 /dev/rsd0<letter>
```

17. After the dump has completed, press the **L1-A** keys to move to monitor mode.

18. Enter the following command to boot the system:

```
>b sd()
```

After the system boots, a login prompt appears. The file system is restored and ready to be used.

Copying UNIX Tapes

The `copyt` utility in the `/cri/bin` directory allows you to copy any UNIX tape including level A, B, and C diagnostic tapes, sysadm tapes, boot tapes, and `cpio` and `tar` formatted tapes. You must be logged on the MWS-E as root or any user in the `mws` group in order to use the `copyt` utility. However, the login you use must have read and write privileges to the file partition that is used to copy and transfer files. The file partition must also have enough empty space to store all the files on the tape that you want to copy. For these reasons, you should have `root` privileges and use the `/var` partition when using the `copyt` utility.

The `copyt` utility uses the `dd` utility in three steps to copy a tape. First, files are copied from a source tape to your MWS-E hard disk drive. Second, the files on the hard drive are copied onto a second tape, the destination tape, which is loaded into the streaming tape drive. Third, the files on the hard drive are erased.

Use the following procedure to make a copy of any UNIX tape:

1. Log in as **`root`** or use the **`su`** command to gain superuser privileges.

2. Enter the following commands:

```
mws1234# cd /var
mws1234# /cri/bin/copyt
```

   The following prompt is displayed:

```
Load source tape and hit any key   (q = quit)
```

3. Load the source tape that you want to copy into the streaming tape drive and close the latch.

4. Press any key except **q**.

   The files on the source tape are copied into available space in the `/var` file partition on the hard disk drive. Messages similar to the following screen are displayed:

```
copyt: reading file copyt0
0+1 records in
0+1 records out
```

   After all files on the source tape are copied, the following prompt is displayed:

```
Load destination tape and hit any key (q = quit)
```

5. Load a write-enabled tape into the streaming tape drive and close the latch.

6. Press any key except **q**.

   The files on the hard disk drive are copied to the streaming tape. Messages similar to the following screen are displayed:

```
copyt: writing file copyt0
0+1 records in
0+1 records out
```

   After the copying process is complete, the files on the hard drive are erased and the following message is displayed:

```
copyt: tape copy done
```

7. Remove and label the tape and add it to your backup tape library.

Adding a User to the System

You can add a user to the system by performing several manual steps and editing several files; however, an easier way to add a new user is to use the `add_user` script. The `add_user` script performs the following functions:

- Adds a line for the new user in the /etc/passwd file
- Creates a home directory for the new user
- Sets the appropriate user and group IDs for the user and the user's home directory
- Places the following startup files in the user's home directory

If you need to add a user to the MWS-E system, use the `/var` directory. Do not add users to the `/cri` file system; this is a CRI proprietary directory that should be accessible only to the `mws` login. Search for "Administering User Accounts" on the AnswerBook CD or in the *Sun System & Network Manager's Guide* for detailed information.

The following procedure describes how to use the add_user script:

1. Log on as root.

2. Enter the following command:

```
mws1234# cd /usr/etc/install
```

3. Enter the add_user command in the following format (the command arguments, each separated by a space, are: username, userID, groupID, the user's full name, the user's home directory, and shell).

```
mws1234# add_user far 1006 1103 "Frank Roberts" /var/far /bin/csh
```

Look at the `/etc/passwd` to find appropriate user and group IDs. Assign a group ID number for the user that is different than the MWS-E maintenance group (other than the mws login, 10002, for example). This ID should be different than the MWS-E maintenance group.

Crontab Files

The `cron` daemon is used to run commands at regularly scheduled dates and times. The commands are listed in `crontab` files in the `/var/spool/cron/crontabs` directory. The `crontab` files are assigned to single users as shown in the following screen:

```
mws1234# cd /var/spool/cron/crontabs
mws1234# ls
mws   root
```

The `crontab` command and options are used to create, edit, delete, or list a user's `crontab` file. The `crontab` command is used to edit, delete, or create the file. The following table lists the different `crontab` commands.

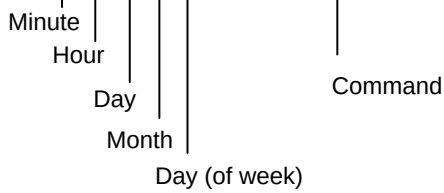
Table 5-4. crontab Command Options

Syntax	Description
`crontab [`*`filename`*`]`	Copies the specified file to the `/var/spool/cron/crontabs` directory.
`crontab –e [`*`username`*`]`	Edit the user's file with the `vi` editor.
`crontab –l [`*`username`*`]`	List the command in the user's `crontab` file. If no user is specified, then the file for the user who entered the command is listed.
`crontab –r [`*`username`*`]`	Removes the user's `crontab` file. The superuser can remove any `crontab` file with this command.

Crontab File Fields

Each line in a `crontab` file consists of six fields that are separated by a space or tab as shown in the following screen. These fields allow the user to set specific times and dates to run a command.

```
mws1234$ crontab -l
00 0 * * 1 /cri/bin/pmnotify –w
00 0 1 * * /cri/bin/pmnotify –m
00 0 1 1,4,7,10 * /cri/bin/pmnotify –q
00 0 1 1,7 * /cri/bin/pmnotify –s
00 0 1 1 * /cri/bin/pmnotify –a
```



- The minutes field can have a value from 0 through 59.
- The hours field can have a value from 0 through 23.
- The day of the month field can have a value from 1 through 31.
- The month field can have a value from 1 through 12.
- The day of the week field can have a value from 0 through 7. Sunday can be either day 0 or day 7.
- The last field is the command to be executed including any arguments.
- Asterisks (*) indicate that the command is run for all possible values of the field. For example, an asterisk in the Day field indicates that the command will run every day.

In the example shown above, the third line indicates that the `pmnotify –q` command is run during the first minute of the first hour, on the first day of the month. The command will execute four times a year (January, April, July, and October) and will run every day of the week.

Changing Your Crontab File

One method commonly used to safely change a `crontab` file is described below:

1. Enter the following command to list the contents of your `crontab` file and redirect the output to a separate file:

```
mws1234# crontab –l > crontab.orig
```

2. Copy the original file to a temporary file:

```
mws1234# cp crontab.orig crontab.tmp
```

3. Change the contents of your temporary file using the **`vi`** editor.

4. Enter the following commands to copy the edited temporary file back to the `/var/spool/cron/crontabs` directory and then delete the temporary file:

```
mws1234# crontab crontab.tmp
mws1234# rm crontab.tmp
```

Laser Printer Administration

Print jobs are sent from the MWS-E to the laser printer connected to serial port A on the OWS-E. To enable this network printing, certain printer control and network files must be properly configured as described in the following subsections.

Printing with the Laser Printer

The `/etc/printcap` file is used to define printer capabilities. The print spooling system references this file every time you print. Both the MWS-E and the OWS-E must have `/etc/printcap` files as shown in Figure 5-1 (replace `owsS/N` with the name and serial number of your OWS-E).

The MWS-E `printcap` file usually has one entry that references the remote printer `lp1` that resides on the OWS-E. The OWS-E `printcap` file usually has two entries, `lp` and `lp1`. The `lp` definition is used to

print NeWSprint/PostScript files. The `lp1` definition is used to print ASCII files, and it enables the `mws` login to use the `cfl` command to print online diagnostic listings as described on page 4-27.

MWS-E

```
lp|ljIII|Hewlett Packard LaserJet III:\
        :lp=:rm=owsS/N:rp=lp1
```

OWS-E

```
# entry for an HP LaserJet III NeWSprint printer on a serial port
lp|HP|HP, a HP LaserJet III printer:\
        :lp=/dev/ttya:\
        :sd=/var/spool/HP:\
        :lf=/var/spool/HP/log:\
        :af=/var/spool/HP/acct:\
        :if=/usr/newsprint/lpd/if:\
        :gf=/usr/newsprint/lpd/gf:\
        :nf=/usr/newsprint/lpd/nf:\
        :tf=/usr/newsprint/lpd/tf:\
        :rf=/usr/newsprint/lpd/rf:\
        :vf=/usr/newsprint/lpd/vf:\
        :cf=/usr/newsprint/lpd/cf:\
        :df=/usr/newsprint/lpd/df:\
        :of=/usr/newsprint/lpd/of:\
        :mx#0:\
        :sf:\
        :sb:\
        :br#19200:\
        :xc#0177777:\
        :ms=-parity,ixon,-opost,-ixany:

lp1:\
        :lp=/dev/ttya:sh:lf=/var/adm/lpd-errs:\
        :br#19200:ms=-clocal,crtscts,pass8,-echo,ixon,ixoff:
```

Figure 5-1. MWS-E and OWS-E /etc/printcap Files

The default printer is the `lp` entry defined in the `/etc/printcap` file. If an MWS-E user prints a file using an `lp` or `lpr` command without specifying a particular printer, the printer described by the `lp` entry is used by default. The default printer on the MWS-E uses the remote `lp1` printer on the OWS-E. The default printer on the OWS-E, (again defined by the `lp` entry), uses the NeWSprint software.

NOTE: When installing OWS-E software, make sure the `/etc/printcap` file contains an `lp1` printer entry as shown in Figure 5-1. Not all the OWS-E software installation scripts create the needed entry.

Related Network Files

In addition to the `/etc/printcap` files, two network-related files must be properly configured to enable printing on the LaserJet printer from the MWS-E. The `/etc/hosts` files on both the MWS-E and the OWS-E must contain the internet address and hostname for both systems as shown in Figure 5-2 (replace `000.00.00.0` with the correct internet addresses).

```
#
#       127 – loopback
#
127.0.0.1       localhost loghost
#
000.00.00.0     mws1234 mws1234.cray.com                #Sun370 MWS–E
000.00.00.0     ows1600 ows1234.cray.com                #Sun370 OWS–E

   .               .
   .               .
   .               .
```

Figure 5-2. The /etc/hosts File

The other network-related file needed to enable printing from the MWS-E is the `/etc/hosts.lpd` file. The `/etc/hosts.lpd` file shown in Figure 5-3 resides on the OWS-E. It is not included as part of a standard software release. The `/etc/hosts.lpd` file must be created by the OWS-E administrator. The file contains a list of remote hosts that are allowed access to the OWS-E printer; this file must contain the MWS-E host name.

```
mws1234
```

Figure 5-3. The /etc/hosts.lpd File

The `/etc/hosts.lpd` file can list other hosts on the network in addition to the MWS-E. If the UNICOS printer daemon on the mainframe is enabled, it can access the OWS-E printer just like the MWS-E.

Line Printer Daemon

The line printer daemon (`lpd`) must be running on both the OWS-E and the MWS-E to enable remote printing. Use the following command to find out whether `/usr/lib/lpd` is running:

```
ps -ax | grep lpd
```

If `lpd` is not running, enter the following **`/usr/lib/lpd`** command to start the `lpd`. Refer to the `lpc` and `lpd` man pages for more information.

Restarting the lpd Daemon

Whenever changes have been made to the `/etc/printcap` files or the `/etc/hosts.lpd` file on the OWS-E, the line printer daemon (`lpd`) should be restarted as shown in the following screen:

MWS-E

```
mws1234# lpc restart all
lp:
        no daemon to abort
lp:
        daemon started
```

The `no daemon to abort` message appears as part of the normal output of the `lpc` command. The output looks somewhat different when the command is executed on the OWS-E:

OWS-E

```
mws1234# lpc restart all
lp:
        no daemon to abort
lp:
        daemon started
lp1:
        no daemon to abort
lp1:
        daemon started
```

Submitting Print Jobs

Users of the MWS-E or the OWS-E may send print jobs to the printer using the `lp` or `lpr` commands. If a user wishes to specify a printer, the `-d` option is used with the `lp` command, and the `-P` option is used with the `lpr` command:

```
ows1234$ lpr -Plp1 file_name

OWS1234$ lp -dlp1 file_name
```

Monitoring and Canceling Print Jobs

Use the `lpstat -t` command to monitor print jobs. This command gives a relatively detailed listing of print jobs and the status of both local and remote printers. In the following example, the `lpstat -t` output is shown after a print job has just been submitted from the MWS-E using the `cfl` command.

```
mws1234$ cfl -f7 -l10 yaab
mws1234$ lpstat -t
Local scheduler running

the default printer is lp1 on remote host ows1234

lpstat: printer classes not supported

device for ljIII is the remote printer lp1 on ows1234

lp:
        queuing is enabled
        printing is enabled
        1 entry in spool area
        sending to ows1234

ljIII:
lp1 is ready and printing
Rank   Owner      Job  Files                                 Total Size
active mws       902  /usr/tmp/cflBAAa00666                 14352 bytes
```

The `lprm` command is used to cancel print jobs. The print job number must be specified with this command. Also, if the print job is running on a printer other than the default `lp` printer, the name of the printer must be specified with the `-P` option. In the following example, job 22 has been canceled on the OWS-E `lp1` printer:

NOTE: Users may cancel only their own print jobs, but a superuser can cancel any job.

```
ows1234$ lpstat -t
       .
       .
       .

lp1 is ready and printing
Rank   Owner      Job  Files                                 Total Size
active mws        21   /usr/tmp/cflBAAa00392                 14352 bytes
1st    mws        22   /usr/tmp/cflBAAa00396                 14352 bytes

ows1234$ lprm -Plp1 22
dfA022mws1234 dequeued
cfA022mws1234 dequeued
```

Common Printer Problems

Printer error messages are usually displayed in the console window. Errors are also logged in the `/var/adm/lpd-errs` file, which is automatically created when an error occurs.

System administrators should be aware that certain print jobs can take a relatively long time to process. One example is printing out screen snaps created with the OpenWindows Snapshot tools. The NeWSprint software on the OWS-E can process these raster files; however, it does take a long time to print the image. The printer daemon may appear to hang for up to 30 minutes when you are printing screen snaps or raster images; this is normal.

Another common problem with MWS-E/OWS-E printing is improperly configured `/etc/printcap` files. Printer definitions must begin in the left-most character position and must follow the correct syntax as shown in Figure 5-1. Incorrect syntax will result in `unknown` printer error messages.

If diagnostic listings printed from the MWS-E are not in the correct 132-column format, it is likely that the MWS-E `/etc/printcap` printer definition for `lp` is incorrect. This entry must point to the `lp1` printer on the OWS-E. Pointing to any other printer results in errors.

If the OWS-E printer is not responding to any MWS-E print requests, verify that the OWS-E has an `/etc/hosts.lpd` file that includes the MWS-E hostname. Also verify that both machines have accurate `/etc/hosts` files that contain the internet address and host name of the other workstation.

Finally, if any changes have been made to the `/etc/printcap` or `/etc/hosts.lpd` printer control files, restart the printer daemon using the `lpc restart all` command.

Repairing Defects on the Disk Drive

Media defects and flaws can occur on the hard disk drive. The `format` utility is used for disk partitioning and maintenance, and for repairing defective blocks. An error message appears on the console display when the operating system encounters a new flaw on the hard drive. The error message indicates the logical block number of the bad sector; the message also indicates which file system is affected and the relative block number within that file system. The logical block number is the value that must be used for the repair.

CAUTION

Do not attempt the following formatting procedure if your hard disk has not been reformatted with SunOS 4.1.2 (Solaris 1.01). The reformatting procedure is performed as part of the ME-Y2.0 installation. Incompatibility between SunOS 4.1.2 format utility and drives preformatted with earlier releases could lead to corruption of the manufacturer's defect list for your hard disk drive.

1. To repair the defect, log in or `su` to root and enter the following command:

```
mws1234# format
```

   The `format` utility scans for disk drive devices and prompts for the drive number as shown in the following screen:

```
Searching for disks...done


AVAILABLE DISK SELECTIONS:
        0. sd0 at sm0 slave 0
           sd0: <SUN0669 cyl 1614 alt 2 hd 15 sec 54>
Specify disk (enter its number): 0
```

2. Enter **`0`** for the hard disk drive. The `format` main menu appears as shown in Figure 5-4.

```
selecting sd0: <SUN0669>
[disk formatted, defect list found]
Warning: Current Disk has mounted partitions.


FORMAT MENU:
        disk       – select a disk
        type       – select (define) a disk type
        partition  – select (define) a partition table
        current    – describe the current disk
        format     – format and analyze the disk
        repair     – repair a defective sector
        show       – translate a disk address
        label      – write label to the disk
        analyze    – surface analysis
        defect     – defect list management
        backup     – search for backup labels
        quit
format> repair
```

Figure 5-4. format Utility Main Menu

3. Enter **`repair`** to begin to repair the defective block.

   The format utility prompts you to enter the block number of the defect.

```
Enter block number of defect: <logical block number>
```

4. Enter the logical block number that was reported in the error message.

   If the error message is no longer visible on the console device, search the `messages.`*x* files under the `/var/adm` directory. All operating system error messages are logged in these files.

   The `format` utility indicates whether the defective block is in a mounted file system or partition.

```
Repair is in a mounted partition, continue? y
```

5. Enter **`y`** to continue.

After a few moments, the block is repaired and the block number is displayed using both logical block number and the cylinder, head, and sector address.

```
Repairing block (logical block number)  cyl/hd/sec
...done

format> q
```

6. Enter **q** to exit the `format` utility.

   The defect has now been repaired. The bad block has been marked as a known flaw and added to the defect list. The data residing in the defective block has been moved. Because the defect has been added to the list of known defects, subsequent reformatting of the drive should not present any problems.

The `format` utility can also be used to analyze the disk and redefine the partition table and disk type. For more information on the `format` utility, refer to Sun Microsystems, Inc.'s *System & Network Administration Manual* or search for *format* on the AnswerBook compact disc.

6 MWS-E SYSTEM SECURITY

As a Cray Research, Inc. (CRI) employee, you are responsible for protecting sensitive company informational assets. As an MWS-E user, you must protect your computer accounts and the information available through them from unauthorized use. Protecting your computer accounts is not difficult to learn but takes some time and some thought.

Passwords

Using passwords ensures the account you are using can be accessed only by you. If you devise good passwords and change them reasonably often, it is very difficult for another person to use your accounts. Good passwords have the following characteristics:

- They contain at least 6 characters.
- They contain a mixture of cases, numbers, and special characters.
- They do not contain personal information (login, name, friends' names).
- They do not contain dictionary words.
- They do not contain names or words spelled backwards.

Follow these suggestions to create a secure password that is still easy to remember:

- Misspell a dictionary word and then add a miscellaneous digit.
- Pick an unusual word; for example, something from recent news articles.
- Combine two character strings and concatenate them with a special character in the middle.

Change your password frequently, at least monthly. The more often a password is used, the more frequently it should be changed.

Password Aging

Be sure to change the root and all user passwords at least once a month. Changing them monthly helps protect CRI and customer information on the MWS-E, OWS-E, and mainframe from unauthorized users.

A password-aging mechanism within the operating system is used to force users to periodically change their passwords. Use the following `passwd` command to require a user to change his/her password after a specified number of days (you must be logged in as root):

```
passwd –x number_of_days user_name
```

The following command requires the user pat to change her password the next time she logs on and to also change it again in approximately 30 days.

```
mws1234# passwd –x 30 pat
Changing password for pat on mws1234.
mws1234#
```

The following command displays password aging information for pat (substitute the **`–a`** option for the `user_name` to display information for all users on the system). The date of 00/00/00 indicates that pat has not logged in since password aging was assigned to her login.

```
mws1234# passwd –d pat
Changing password for pat on mws1234.
pat    00/00/00 0 35
mws1234#
```

Because UNIX operating systems include encrypted passwords, changing passwords at least monthly may prevent an unauthorized user from cracking them.

umask Setting

The default umask on the MWS-E systems is normally set to 022 or 027; but in very secure systems, it may be set to 077. Table 6-1 explains the various umask settings.

Table 6-1. Common umask Settings

umask Setting	File	Permission	Users	Directory	Permissions	Users
000	666	Read/write Read/write Read/write	Owner Group World	777	Universal Universal Universal	Owner Group World
022	644	Read/write Read Read	Owner Group World	755	Universal Read/execute Read/execute	Owner Group World
026	644	Read/write Read Read	Owner Group World	751	Universal Read/execute Execute	Owner Group World
027	640	Read/write Read None	Owner Group World	750	Universal Read/execute None	Owner Group World
077	600	Read/write None None	Owner Group World	700	Universal None None	Owner Group World

umask Command

The `umask` command is used to display and change your current `umask` setting. New files and directories created on the 027 systems (where a specified group is private to the account holder) or 077 systems (where a specified group contains more than one account) is private to the creator unless a user `umask` is supplied or the permissions on the files or directories are changed.

Permissions on existing files and directories, including home directories, do not change. File system administrators should consider changing the permissions of the home directories they administer.

Preventing Root Login from the Console

Enabling root login directly from the graphics display console presents a security risk. You should discourage and prevent this practice of logging on the system as root. Your MWS-E is more secure if a user must use the `su` command to become root user.

You can prevent root login on the console by editing the `console` line in the `/etc/ttytab` and changing the `secure` keyword to `unsecure` as shown in the top line of the following screen display:

Enables Root Login on the Console

Does Not Allow Root Login on the Console

```
console "/usr/etc/getty std.9600"      sun      on local  secure

console "/usr/etc/getty std.9600"      sun      on local  unsecure
```

Also, if the `console` entry does not have the `secure` keyword (the entry is set to `unsecure`), a user must enter the root password when attempting to boot the system into single-user mode. This provides a further security measure by preventing someone from breaking into the workstation by entering the `L1-A` command and then booting the system into single-user mode.

Login Accounts

Your accounts are proprietary–for your use only. Account passwords should not be shared. Administrative accounts are the sole exception to this rule, and passwords for these accounts should be changed very frequently. Your computer accounts should be set up to ensure that files created by you are either private to you or restricted to members of your group. Ownership and group membership information, file and directory permissions, and the file and directory creation mask (`umask`) control access to the MWS-E.

Use the following guidelines to ensure security of accounts:

- Check permissions on your home directories and on all directories and files directly below your home directory. If your home directory can be read by others, ensure that access to files and directories in your home directory is restricted as appropriate. Your ‘‘.’’(dot) files such as `.cshrc`, `.profile`, `.rhosts`, and `.login` do not need to be read by anyone else.

- Restrict access to any directory that contains Cray Research private or Cray Research proprietary information.

- Set your own `umask` in your `.cshrc` or `.profile`; the default `umask` in most systems is probably much more open than you really want it to be for your own use. Using `umask` 077 ensures that files and directories you create from now on are private to you. Using `umask` 027 makes files and directories you create readable only to the group that owns the current directory.

- Find the groups of which you are a member. Use the `chgrp` command to change the group ownership of files and directories that you want to share with a specific group of people. Only the owner of a file, or root, can change the group ownership of a file. Remember that the permissions at each level of your directory tree need to be set to allow appropriate access, not just the permissions on the particular file or directory.

Wheel Group

The overall security level of your workstation can be increased by assigning certain users to the `wheel` group in the `/etc/group` file. The `wheel` group is the root or superuser group. If the `wheel` group has a list of users following the last colon (`:`), only the listed users can use the `su` command to become superuser. Other users cannot use the `su` command to become root, even if they know the root password. If there are no user login names listed after the `wheel` group, any user who knows the root password can use the `su` command.

In the `/etc/group` file shown, only users `mws` and `abc` can use the `su` command to gain superuser privileges. The `/etc/group` file should be set to a permissions mode of 644 and be owned by root.

```
wheel:*:0:mws,abc
nogroup:*:65534:
daemon:*:1:
kmem:*:2:
bin:*:3:
tty:*:4:
operator:*:5:
news:*:6:
uucp:*:8:
audit:*:9:
staff:*:10:
other:*:20:
mws:*:1102:mws,ssqa
```

Figure 6-1. Wheel Group Assignments in the /etc/group File

Preventing Password-free Logins over a Network

The `/etc/hosts.equiv` file is used to specify remote hosts that are considered trusted. Users from trusted hosts can log in to a local system without supplying a password. The default `/etc/hosts.equiv` file contains a single "`+`" entry on a separate line. This line indicates that all remote hosts are trusted, which presents a security risk. In most situations, this file is not needed on either the MWS-E or OWS-E, and it

is suggested that you remove this file or delete the + line (the file is then empty). If the `hosts.equiv` file must be used, it should never contain a single + entry on a separate line.

Login Spoofs

A login spoof imitates the login sequence that every user must use to gain access to UNIX. A login spoof can reside on an unattended terminal waiting for an unsuspecting user. For example, you may log on to your system and enter your password, and the system responds ‘‘login incorrect.’’ You think you typed in the wrong login or password. However, the login spoof actually sends your login and password to an unauthorized user who is trying to gain access to your UNIX system, and then it exits you to the real login program. You would then re-enter your login and password to gain access to your UNIX system, thinking you initially entered the wrong login or password.

Trojan Horses

A Trojan horse is an undesirable program that has the same name as a UNIX command, but runs a sequence of actions different from those of the UNIX command. Trojan horses have unexpected effects.

Two easy ways to guard against Trojan horses are to hardcode your PATH variable so that the necessary directories are in the correct order, or to execute only legitimate system programs from system directories. The latter way to guard against Trojan horses with UNIX systems is to ensure the current working directory is not a part of your PATH variable. The PATH variable controls the directory search order. While most systems have a dot (**.**) first in the directory search order as a shortcut to aid software developers, this shortcut can leave you vulnerable to unauthorized users.

With a dot in your path, any time you go outside of your own directory tree you become vulnerable, because you may inadvertently execute a program in the current working directory, when in fact you want to execute another (system) program of the same name in a completely different directory. Suppose you want to print the contents of a file in someone else’s directory, and you move into their directory before printing the file. If by chance (or design), they have a program called ‘‘cat’’ in that directory, you will execute their version of ‘‘cat’’ (which may not have anything to do with printing the contents of files), rather than the system version. The safest alternative is to not use a dot as a part of any path name; if you must use it, move it to the end of your path search list.

Any directory in your search path that can be written to by another user can be an entry point for a Trojan horse. The most likely candidate besides system files (which are reasonably well protected) is your own bin directory; if it can be written to by others and is included in your path, you are vulnerable. If you need to have a place for others to put executable programs, create a temporary directory in which they can write and move only binary files that you trust into your (private) bin directory. That way, you will always know exactly what is in that directory and what affect it will have on your account or directory.

To secure your PATH variable from Trojan horses, place your current directory (**.**) at the end of the `PATH` variable. For example, change the `PATH` variable in `/etc/profile` from:

```
PATH=/usr/ucb:.:/bin:/usr/bin:/usr:local:bin
```

to:

```
PATH=/usr/ucb:/bin:/usr/bin:/usr/local/bin:.
```

The root user should also hardcode his or her `PATH` variable so the current directory is at the end of the path.

MWS-E Physical Security

If you are going to leave the MWS-E for any length of time, take steps to ensure that your terminal cannot be used by others. Never leave your terminal logged on; if you are leaving for the day, or for an extended period of time, log off.

It is your responsibility, whether you are a root user or a group user, to provide the required security for the MWS-E system. Always keep boot tapes and backup tapes locked in a secure location so unauthorized users cannot access them and gain root privileges on the system.

.rhosts (rcp, rsh, rlogin) File

The UNIX `.rhosts` file specifies a list of system names, and perhaps account names, that are allowed password-free access to your computer account. Allowing password-free access is a common, but insecure, practice that allows users to save time once they have logged on to one machine and want to move to others. Be careful about the systems you place in the `.rhosts` file. Restrict the entries you place in the `.rhosts` file to machine names you regularly need to access (for example, external systems such as the Minnesota Supercomputer Center systems should never be placed in your `.rhosts` file).

Only secure, internal systems that you work with on a regular basis should be in your `.rhosts` files. Only the owner of a `.rhosts` file should have write permission to the file. A `.rhosts` file that can be written to by anybody (world write permissions) can allow anybody password-free access.

File Transferring: ftp and ftpd

When you retrieve files using the get command with `ftp` (file transfer program), the files are created under the control of your `umask` (if you have one), or the user default `umask`; in either case, the files are at least somewhat protected. When you send files using the `put` command with `ftp`, the files are not protected.

NOTE: Files sent using the `put` command to a remote system by using `ftp` are placed there by a daemon process called `ftpd.ftpd`, which is started from the system shell and which runs with a `umask` of 000; any files you send using the `put` command on a remote system are created with permissions 666 read/write to anyone in the system.

To avoid problems when using `ftp`, arrange your sessions so that you can always retrieve files but not send them. Use of `.netrc` files (configuration files for the `ftp` command) is strongly discouraged. Never place passwords in `.netrc` files or any other file; outside users should not have access to your passwords.

NOTE: Online manual pages describing the `ftp`, `ftpd`, and `get` commands are available. Use the `man` command with the desired command name to display this information.

Summary

Employ the following measures to promote system security:

- Choose a secure password and be sure to change it frequently.
- Evaluate permissions on all of your directories and files on all of your accounts; make sure they protect CRI information and do not expose your account to exploitation (intended or not) by others.
- Set an appropriate umask.
- Remove any `.netrc` files.
- Restrict the number and type of systems in your `.rhosts` files.

7 WACS USER INFORMATION

This warning and control system (WACS) programs that were previously described in this section are no longer distributed.

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8 EASE ERROR LOGGER

The software that was previously described in this section is no longer supported and will not be functional after the year 2000.

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9 INSTALLING AND USING ANSWERBOOK

This section describes how to install and use the Solaris 1.0.1 AnswerBook system software compact disc (CD). This section provides the information you need to install and use AnswerBook under the `mws` login environment on the model E maintenance workstation (MWS-E) running OpenWindows 3.0 and SunOS 4.1.2. Refer to the *Using the AnswerBooks* document for additional information; this manual is included with the AnswerBook system software package that is shipped with each MWS-E system.

AnswerBook is an online document retrieval system that enables you to view all of the manuals in the SunOS 4.1.2 and OpenWindows documentation set. The Solaris 1.0.1 AnswerBook CD contains two separate AnswerBook systems: OWV2 supports OpenWindows version 2.0 and OWV3 supports OpenWindows version 3.0. All AnswerBook information displayed on the screen closely matches the printed manuals. Note that a complete set of printed manuals is included with all operator workstation model E (OWS-E) systems in addition to the AnswerBook system software. AnswerBook provides several features like searching, creating bookmarks, and hypertext cross-reference links that make it easier and faster to access and read the information on the screen.

Installing AnswerBook

Use the following procedure to install the AnswerBook system software on the MWS-E hard disk drive. This installation uses approximately 5 Mbytes of space in the `/usr` file system.

This procedure takes approximately 20 minutes to complete.

1. Remove the AnswerBook CD from its case and place it into a CD caddy.
2. Insert the caddy into the CD-ROM player on the MWS-E.
3. Log on to the MWS-E as `mws`.

4. Enter the following command to gain superuser (`root`) privileges:

```
mws1234$ su root
```

5. Enter the following command to create a `/cdrom` directory:

```
mws1234# mkdir /cdrom
```

6. Enter the following command to mount the CD to the `/cdrom` directory:

```
mws1234# mount –r /dev/sr0 /cdrom
```

7. Enter the following command to move to the `/cdrom` directory:

```
mws1234# cd /cdrom
```

8. Enter the following command to start the installation program:

```
mws1234# cdm
```

The following menu is displayed:

```
----->>>>> CDM <<<<<-----

        1.  Select Application
        2.  Show Current Application
        3.  Install Application
        4.  Display Application Text File
        5.  Print Application Text File
        6.  List Applications
        7.  List Categories
        8.  Change Current Category
        9.  Change Current Directory
        10. Show Program Environment

Please enter a number or q to quit: 1
```

9. Enter **1**. The following menu is displayed:

```
Applications available:

        1.  Solaris/OWV2
        2.  Solaris/OWV3

Please enter a number or q for the main menu: 2
```

10. Enter **2** to install the OpenWindows version 3.0 release of AnswerBook. The following menu is displayed:

```
"Solaris/OWV3" selected as new application.

----->>>>> CDM <<<<<-----

        1.  Select Application
        2.  Show Current Application
        3.  Install Application
        4.  Display Application Text File
        5.  Print Application Text File
        6.  List Applications
        7.  List Categories
        8.  Change Current Category
        9.  Change Current Directory
        10. Show Program Environment

Please enter a number or q to quit:3

Begin installation now? (y/n): y
```

11. Enter **3** and then enter **y** to begin the installation.

12. A series of information screens is displayed and questions are asked. Answer yes (**y**) and press the **<RETURN>** key to display the following `Select Disk Configuration` screen.

```
   Configuration   Performance   Estimated Size   Installation Time
   -------------   -----------   --------------   -----------------
1  CD-ROM Based        Slowest         4 Mbytes    1 to  2 Minutes
2  CD-ROM/Hard Disk     Faster        50 Mbytes   15 to 30 Minutes
3  Hard Disk           Fastest       240 Mbytes   45 to 75 Minutes

   [] Use the value for "Disk Configuration" from
      your Installation Planning Worksheet.

Select desired configuration (or 4 to Quit) [1 - 4]:  1
```

13. Enter **1** to install the `CD-ROM Based` configuration. The following `Install/Customize Menu` is displayed:

```
Install/Customize Menu
======================
   1  Perform Installation
   2  Customize Configuration
   3  QUIT Installation

Select desired action [1 - 3]: 1
```

14. Enter **1** to select `Perform Installation`.

```
Specify CD-ROM Mount Point
==========================

        If users will mount (access) the CD-ROM partition by a different
        path name than the one used during installation, you must change the
        CD-ROM mount point here so that it matches what users will see.

        [] Use the value for "CD-ROM Mount Point For Users" from your
           Installation Planning Worksheet.

The CD mount point is currently set to "/cdrom"
Enter new CD-ROM mount point, or hit Return to use current value.

        CD-ROM mount point: <RETURN>
```

15. Press **<RETURN>** to transfer AnswerBook files from the CD to the hard disk drive.

The following screen is displayed when the installation is complete.

```
Installation of "AnswerBook Home Directory ($ABHOME)"
            in "/usr/AnswerBook/SysSoft1.3" successful

   Search Indexes/Book Databases Left on CD (as requested)

   PostScript Files Left on CD (as requested)

Installation of "AnswerBook Binaries"
            in "/usr/openwin/bin/xview" successful

Installation of "Help Files"
            in "/usr/openwin/lib/help" successful

Installation of "AnswerBook1.3" is complete; it is ready to use

Do you want to know on which file systems items were installed [y|n]: y
```

16. Enter **y** to continue.

```
Installation of "AnswerBook" is complete; it is ready to use

Do you want to know on which file systems items were installed [y|n]: y

      .
      .
      .
      .

Hit the Return key to continue: <RETURN>
```

17. Enter **y** to display all installed files. A list of all AnswerBook files written to the /usr file system is displayed. Then press the **<Return>** key again to complete the installation procedure.

18. Enter **q** from the main CDM menu to access the CD manager program.

19. Enter the following commands to set proper file and directory permissions:

```
mws1234# chmod 755 /usr/AnswerBook
mws1234# chmod 755 /usr/AnswerBook/SysSoft1.3
```

20. Log off as `root`.

    The `/cri/mws/.profile` file should have a `$PATH` variable set that can access the AnswerBook binary files in the `/usr/openwin/bin/xview` directory.

21. You are now ready to use the AnswerBook system. Enter the following command to start AnswerBook:

```
mws1234: answerbook&
```

A copy of the AnswerBook installation process and a list of where all AnswerBook files are installed are located in the `/usr/tmp/unbundled/1.3_AnswerBook.log` file.

Removing the AnswerBook CD from the MWS-E

The AnswerBook CD can be accessed only as a mounted file system, which means the CD must remain installed in the CD-ROM player. Use the following procedure to unmount the file system and to remove the CD from the CD-ROM player.

1. Log on to the system as root.

2. Enter the following command to unmount the file system on which the CD is mounted. This file system should be `/cdrom` as described in the “Installing AnswerBook” procedure.

```
mws1234# /usr/etc/umount /dev/sr0
```

3. Enter the following command to eject the CD:

```
mws1234# eject /dev/sr0
```

4. To remount the AnswerBook CD, reinsert the CD and enter the following command:

```
mws1234# /usr/etc/mount –r /dev/sr0 /cdrom
```

Using AnswerBook

You are ready to use AnswerBook after you have installed AnswerBook as described earlier. You can enter **answerbook** from any mws login xterm window to start the AnswerBook system. You can also select AnswerBook from the "Workspace Programs" menu as described on the following page.

NOTE: To access online documentation, the AnswerBook CD must be loaded in the CD-ROM player and mounted as a file system, unless the entire 240-Mbyte AnswerBook system is installed on the hard disk drive.

After entering **answerbook**, the "Navigator" and "Viewer" windows appear. These windows are used to search for information and browse through documents' tables of contents, and they use several other AnswerBook features. Complete information is described in the *Using the AnswerBooks* manual that is included with the AnswerBook CD. Refer to this manual and experiment with the AnswerBook system. Many of the basic features are easy to understand and use with minimal practice.

When scrolling through AnswerBook online documents, you may want to use the following R keys instead of the available window buttons.

Table 9-1. AnswerBook Page Scrolling Keys

Key	Command	Description
R9	PgUp	Previous page
R3	PgDn	Next page
L4	Undo	Go back
R7	Home	Go to first page of chapter
R13	End	Go to last page of chapter

Adding AnswerBook to Your Workspace Programs Menu

Use the following procedure to add AnswerBook to the ‘‘Workspace Programs’’ submenu for the mws login as shown in Figure 9-1.

Figure 9-1. Workspace Programs Submenu

1. Use the `vi` editor to add the following line to the `.openwin-menu` file. Add the bold line between the `Calendar Manager` and `Clock` lines as shown in the following screen:

```
“Calendar Manager...”     exec $OPENWINHOME/bin/xview/cm
“AnswerBook...”           exec $OPENWINHOME/bin/xview/answerbook
“Clock...”                exec $OPENWINHOME/bin/xview/clock
```

2. If you are running OpenWindows 2.0, you must log off and then log on as `mws` to run the new `.openwin-menu` file. OpenWindows 3.0 users do not need to do this; the file is automatically read each time it is edited.

10 SYSTEM CLEAR UTILITY

This section describes the following software programs that run on the MWS-E and CRAY Y-MP systems with an IOS model E; all are used to clear residual or stored data from different areas of the CRI computer system.

- System clear utility (include in ME diagnostic release)
- System clean program for DD-60s (order from Logistics)
- SecureM release (must be ordered from Logistics)

System Clear Utility

The system clear utility is used to clear the CRAY Y-MP mainframe, IOS-E, and SSD-E of any residual or stored data. The `sysclr` command clears data by writing over it with 0's or a pattern entered by the user.

NOTE: The `sysclr` command does not clear data from disk drives; the `syscln` command is used to clear disk drives. Both the `sysclr` and `syscln` commands use the "System Clear" menu with slight differences. The `syscln` command adds the `Clear Disks` and `Configure Disks` lines to the menu.

System clear files are listed and described in Table 10-1. All four programs in the `/cri/mws/sysclr` directory must remain in the directory to enable you to use the `sysclr` program. These programs clear different portions of the Cray Research system and are written in different languages (APML, and CAL).

Table 10-1. System Clear Utility Programs and Files

Program	Description
`/cri/mws/sysclr`	This is the system clear utility directory.
`/cri/mws/sysclr/iosclr`	This program is used to clear data from the IOS.
`/cri/mws/sysclr/syscln`	This program is used to clear data from DD-60 disk drives. This command displays the “System Clear Utility” menu and provides a user interface to the `dskclr` program in addition to the same programs the `sysclr` command calls. The `syscln` program is not available with the ME diagnostic release; you must order it from Logistics.
`/cri/mws/sysclr/dskclr`	This program is provided with the System Clean (`syscln`) package for clearing data from DD-60 drives.
`/cri/mws/sysclr/sysclr`	This command displays the “System Clear Utility” menu and provides a user interface to the other programs.
`/cri/mws/sysclr/sysclr.conf`	This configuration file is created when you select YES for the `Save Configuration` parameter and run the `sysclr` or `syscln` program. The system clear utility uses this file to load configuration data.
`/cri/mws/sysclr/ympclr`	This program clears data from the following areas: • V, B, and T registers • Performance register for 1, 2, 3, 4, or 8 CPUs • SSD through a VHISP channel • Semaphore registers • Instruction registers • CPU memory

11 NEW WACS USER INFORMATION

This section is obsolete. Please refer to the document titled *xelog, xcfg, and nwacs User Information*, publication number HDM-012-D, for complete user information about `nwacs`.

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Boldface numbers refer to figures and tables.

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