StorageWorks by Compaq

Enterprise Virtual Array
User Guide

Part Number: EK–E2USR–UA. A01

First Edition (July 2002)

Product Version: 2.0

This user guide contains conceptual and procedural information about the *StorageWorks*™ Enterprise Virtual Array Storage System and its online interface.

COMPAQ

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About this Guide

This user guide provides information to help you:

- Learn about the StorageWorks Enterprise Virtual Array by Compaq and its components.

- Start-up your storage system.

- Operate your storage system.

- Understand the HSV Element Manager and its role in the virtual array.

- Understand regulations and specifications.

- Understand EMU generated error condition reports.

- Understand HSV fault management concepts.

- Install customer replaceable units.

Intended Audience

This book is intended for use by Enterprise Virtual Array customers who are experienced with the following:

- SANs and storage systems.

- Networking and virtual storage concepts.

- Enterprise Virtual Array products.

Related Documentation

In addition to this guide, Compaq provides corresponding information:

• *StorageWorks by Compaq Enterprise Virtual Array - How to Get More Information.*

• *StorageWorks by Compaq Enterprise Virtual Array Release Notes.*

• *StorageWorks by Compaq Enterprise Virtual Array Storage System Read Me First.*

• *StorageWorks by Compaq Enterprise Virtual Array Storage System World Wide Name Label.*

• StorageWorks by Compaq HSV Element Manager for Interactive Help.

• *StorageWorks by Compaq Enterprise Virtual Array Configuration Guide.*

• *StorageWorks by Compaq Enterprise Virtual Array Upgrade Instructions.*

• *StorageWorks by Compaq Enterprise Virtual Array License Instructions.*

• *StorageWorks by Compaq Enterprise Virtual Array Catalog of Associated Documentation.*

• *StorageWorks by Compaq Enterprise Virtual Array Storage System Installation Instructions.*

Document Conventions

The conventions included in Table 1 apply in most cases.

Table 1: Document Conventions

Element	Convention
Key names, menu items, buttons, and dialog box titles	**Bold**
File names and application names	*Italics*
User input, command names, system responses (output and messages)	`Monospace font` `COMMAND NAMES` are uppercase unless they are case sensitive
Variables	`Monospace, italic font`
Website addresses	Sans serif font (http://www.compaq.com)

Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.

> **WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life.**

> **CAUTION:** Text set off in this manner indicates that failure to follow directions could result in damage to equipment or data.

IMPORTANT: Text set off in this manner presents clarifying information or specific instructions.

NOTE: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Symbols on Equipment

> **Any enclosed surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.**
>
> **WARNING: To reduce the risk of injury from electrical shock hazards, do not open this enclosure.**

> **Any RJ-45 receptacle marked with these symbols indicates a network interface connection.**
>
> **WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.**

Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. Contact with this surface could result in injury.

WARNING: To reduce the risk of injury from a hot component, allow the surface to cool before touching.

Power supplies or systems marked with these symbols indicate the presence of multiple sources of power.

WARNING: To reduce the risk of injury from electrical shock, remove all power cords to completely disconnect power from the power supplies and systems.

Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manually handling material.

Rack Stability

⚠️ **WARNING: To reduce the risk of personal injury or damage to the equipment, be sure that:**

- **The leveling jacks are extended to the floor.**
- **The full weight of the rack rests on the leveling jacks.**
- **In single rack installations, the stabilizing feet are attached to the rack.**
- **Only one rack component is extended at any time. A rack may become unstable if more than one rack component is extended for any reason.**

Getting Help

If you still have a question after reading this guide, contact service representatives or visit our website.

Compaq Technical Support

In North America, call Compaq technical support at 1-800-354-9000, available 24 hours a day, 7 days a week.

NOTE: For continuous quality improvement, calls may be recorded or monitored.

Outside North America, call Compaq technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the Compaq website: http://www.compaq.com.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions.

Compaq Website

The Compaq website has the latest information on this product, as well as the latest drivers. Access the Compaq website at: http://www.compaq.com/storage. From this website, select the appropriate product or solution.

Compaq Authorized Reseller

For the name of your nearest Compaq Authorized Reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

1

Storage System Description

This chapter provides an overview of the Enterprise Virtual Array and its components. This chapter consists of:

- Introduction
- Key Features and Benefits
- Storage System Components
    — HSV Element Manager
    — SANworks™ Virtual Controller Software (VCS) by Compaq
    — Hardware
        — Physical Layout of the Storage System
        — Fibre Channel Drive Enclosures
        — Fibre Channel Loop Switches
        — HSV Controllers
        — Enterprise Racks

Introduction

The StorageWorks Enterprise Virtual Array is a high performance, scaled capacity on demand, "virtual" RAID storage solution. A complement of the current Modular Array (MA) family of StorageWorks solutions (MA8000 / EMA12000 / EMA16000), it can co-exist in the same Fibre Channel SAN, while providing 2-Gbps end-to-end Fibre Channel technology readiness.

This storage system is designed for the data center where improved storage use and scalability is critical. It meets application-specific demands for consistently high transaction I/O (input/output) and MB data rate performance, and provides seamless capacity expansion, instantaneous replication, and simplified storage administration.

The Enterprise Virtual Array is available with multiple configurations in 41U or 42U racks. Each configuration is optimized for general-purpose commercial environments and high-performance technical computing environments. The solutions include support for multivendor operating system platforms and stringent data center availability enhancements, such as multipathing and clustering.

Figure 1–1 shows a 2C12D Enterprise configuration in a 41U rack.
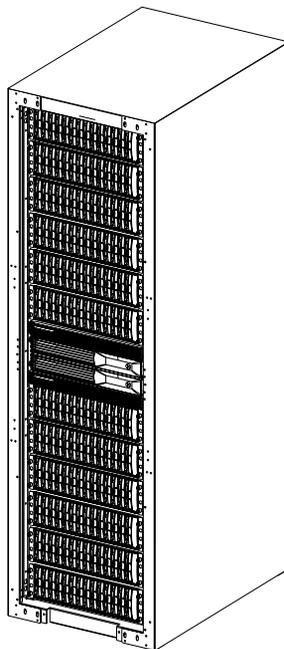
CXO7939A

Figure 1–1: Enterprise Virtual Array 2C12D configuration

Key Features and Benefits

The Enterprise Virtual Array provides the following features:

- Outstanding self-tuning performance:

  — New virtualization technology, Vraid, enables data to be distributed from 8 to 240 disks to increase disk spindle count far beyond traditional RAID sets. This virtualization method also optimizes storage for the best performance of a specific configuration and application. The Enterprise Virtual Array eliminates tedious management functions to provide the best performance possible.

- State-of-the-art controller software:

  — Improves performance, increases capacity, and allows for easy dynamic storage expansion.

- High-density packaging and support of more disks per controller pair:

  — Up to 12 TB of storage in a single 41U or 42U rack.

  — Up to 17.5 TB using 240 disks per controller pair.

- Vsnap - Virtually Capacity-Free Snapshot:

  — Replicate data instantly by taking a picture of the data within seconds without reserving an equal amount of capacity. This process saves significant disk space and improves disk efficiency.

- Virtually Instantaneous Snapclone:

  — Makes a complete copy of your data, which is accessible before the copy completes. The copied data can be used as a test platform for application changes and additional performance benchmarking, as well as for mounting tape backups.

- Easy-to-Order - complete integrated configurations with a single part number:

  — Complete integrated configurations with a single part number, plus disk drives, VCS and system platform software kits.

- Easy-to-use storage management tools:

  — Software tools that allow you to manage larger SAN configurations with more servers and more storage solutions.

Storage System Components

The Enterprise Virtual Array consists of three main components:

- HSV Element Manager—the user interface that communicates with HSV controllers which control and monitor Enterprise Virtual Array Storage Systems.

- VCS—this software allows the Enterprise Virtual Array to communicate with the HSV Element Manager, via the HSV Controllers.

- Hardware—the physical pieces that constitute the Enterprise Virtual Array, such as drives, enclosures, switches, and rack. These pieces are combined in a rack and are connected to the SAN.

These components work together to create an entire storage system solution that stores your data. Management is accomplished by using your browser.

Figure 1–2 shows the complete Enterprise Virtual Array storage solution.
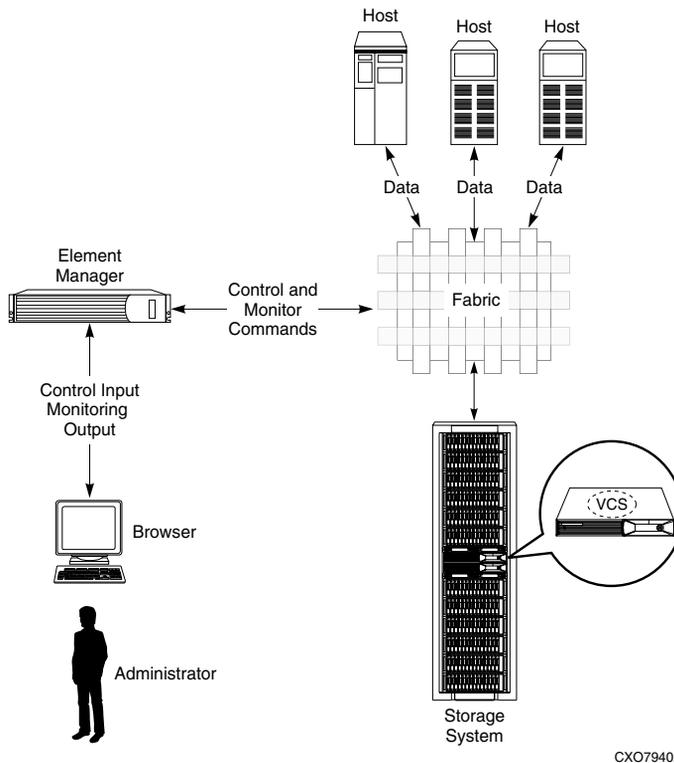
Figure 1–2: Enterprise Virtual Array storage solution

HSV Element Manager

The only user interface to the Enterprise Virtual Array, the HSV Element Manager is opened via the Open SAN Manager and is used to perform all virtual storage pool administration tasks. These tasks include:

- Creating virtual disk families, including selection of Vraid level, cache policy, and host presentation.

- Managing the presentation of VRaid drives to Hosts.

- Managing system hardware located in the rack.

- Creating Snapclones and Snapshots of virtual disks.

An online help system is available within the interface, including page-level help.

Interface Layout

The interface is divided into three panes:

- Session pane—located at the top. Contains high-level commands, and the name and IP address of the SAN appliance.

- Navigation pane—located on the left side. Contains a tree structure for access to virtual disks, hosts, and other elements of the Enterprise Virtual Array.

- Content pane—located on the right side. It is the largest window and is where most administration tasks are performed.

Figure 1–3 shows the HSV Element Manager interface.

Figure 1–3: HSV Element Manager interface window

For more information, see "Organization of the Interface Window" on page 3–4.

HSV Element Manager Online Help

You will find an extensive online help system for the HSV Element Manager. Three levels of help are available:

1. Application—Activated by clicking **Help** on the Session pane. Application help includes:

   • Navigation by a table of contents

   • Index

   • Keyword search function

2. Page—Activated by clicking the **Page Help** button in the Content pane

3. Field—Activated by clicking **?** when displayed next to a field.

Virtual Controller Software

SANworks Virtual Controller Software provides storage controller software capability for the HSV Controller and is provided in the VCS V2.0 software kit.

VCS Benefits

VCS provides scale capacity on-demand, helps improve performance, increases disk utilization efficiency, and allows for easy dynamic storage expansion by providing the following features:

• High-density packaging and support of more disks per controller pair.

• Virtually Capacity-Free Snapshot (Vsnap) function that saves significant disk space and improves disk utilization efficiency.

• Virtually Instantaneous Snapclone copy capability that allows immediate use of the clone copy.

• Simplified storage management such as server independent storage management, automatic load balancing, and on-the-fly storage expansion to multiply management efficiency up to 15 times.

VCS Features and Functionality

VCS provides the following capabilities:

- Support for up to 240 disk drives per controller pair
- Management of up to 512 virtual disks per disk pool ranging in size from 1 GB to 2 TB per virtual disk
- Dynamic capacity expansion and virtual disk data load leveling
- Distributed sparing of disk capacity
- Virtually Capacity-Free Snapshot (Vsnap)
- Virtually Instantaneous Snapclone
- Dual redundant controller operation for increased fault tolerance
- Multiple Path Failover Support
- Battery Back-up for Cache Memory
- Asynchronous Disk Swap (Hot Swap)
- Clustered Server Support
- Mirrored Write-Back Cache Support
- Read-Ahead and Adaptive Read Caching Support
- Virtual RAID Arrays (Vraid0, Vraid1, Vraid5)
- Non-disruptive software upgrade capability
- Supports connection of up to 256 hosts
- Multivendor Platform Support
- Controller Password Protection for Configuration Control
- Selective Storage Presentation
- SAN-based data zoning
- Graphical User Interface (GUI) for management and monitoring

VCS Licensing

One VCS base controller software license is required for each controller pair. Snapshot controller functionality is also available, and requires a separate license that covers a pair of HSV controllers and is ordered separately from the required VCS.

Snapshot controller software is licensed by capacity, based on the disk storage capacity connected to the controller pair. Additional information about SANworks Virtual Controller Software, can be found online at: http://www.compaq.com/products/storageworks/index.html.

Hardware

The Enterprise Virtual Array consists of the following hardware components:

- Fibre Channel Drive Enclosures—A unit that holds storage system devices such as disk drives, power supplies, blowers, Input/Output (I/O) modules, transceivers and Environmental Monitoring Units (EMUs).

- Fibre Channel Loop Switches—An enclosure that provides twelve-port central interconnect for Fibre Channel Arbitrated Loops following the ANSI FC-AL standard.

- HSV Controller—A hardware or firmware device that manages communications between host systems and other devices. A pair of HSV Controllers is included in the Enterprise Virtual Array.

- Enterprise Rack—A floor standing structure designed for, and capable of, holding and supporting storage system equipment.

NOTE: Your Enterprise may consist of one or more of the above hardware elements, depending on your configuration.

Physical Layout of the Storage System

Physically, the Enterprise consists of a pair of HSV controllers and their array of physical disk drives. The basic physical components are shown in Figure 1–4. The physical disk drives connect to drive enclosures, which plug into Fibre Channel (FC) Loop switches. The controller pair is cabled to the FC Loop switches. A backplane in the drive enclosures distributes commands and data to the drives.

❶ HSV Controller pair
❷ FC Loop switch
❸ Drive enclosures

CXO7941A
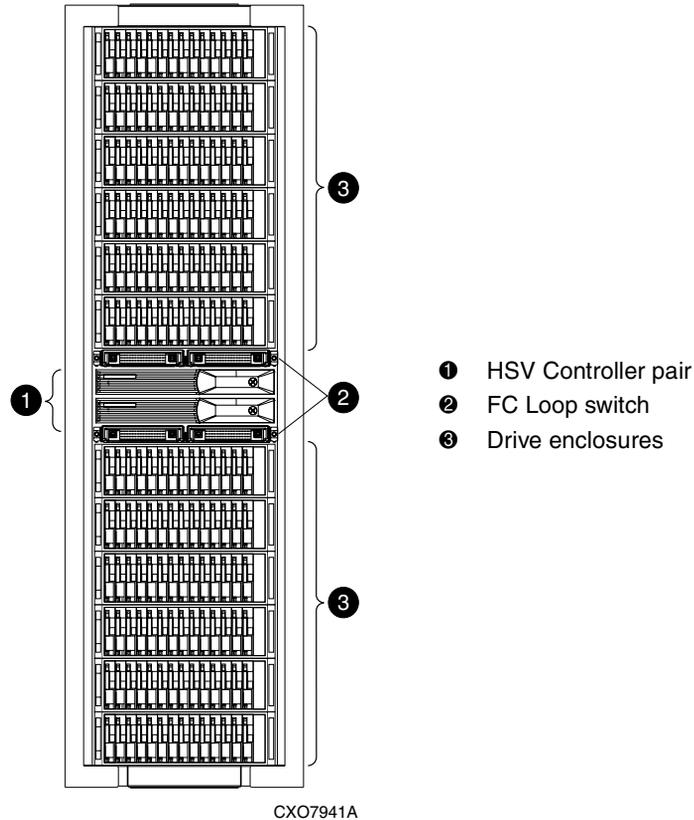
Figure 1–4: Basic storage system hardware components in a 41U rack

Each hardware component is identified in the following sections, and is described in detail in Chapter 4.

Fibre Channel Drive Enclosure

Each Fibre Channel Drive Enclosure includes the following features:

- 3U drive enclosure

- Dual-redundant, active-to-active, 2-Gbps FC loops

- Fourteen 1-inch FC disks per enclosure

- Environmental Monitor Unit

- Dual 2-Gbps FC I/O modules, B and A loops

- Dual-redundant 500-W power supplies

- Dual-redundant blowers

For ease of reference, the disk drives are usually referred to by their physical location, the drive bay number.

Figure 1–5 shows the front view of the FC Drive Enclosure and the physical location of each drive bay.

❶ to ❷ Drive bays
❶ Enclosure status icons

CXO7942A
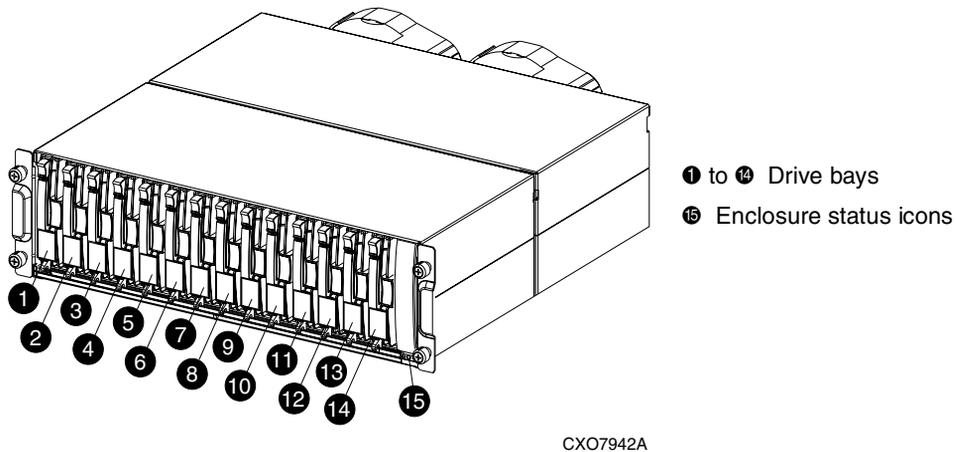
Figure 1–5: FC Drive Enclosure

Fibre Channel Loop Switches

The V2 Enterprise Virtual Array uses four FC Loop Switches to connect all of the drive enclosures to the controller pair via FC cables. Each switch acts as a central point of interconnection and establishes a fault-tolerant physical loop topology.

The major features of the FC Loop Switches are:

- 2.125 Gbps operating speed

- Twelve ports

- Half-width, 1U size

- System and port status LED indicators

- Universal power supply that operates between 100 to 250 VAC (or 50 to 60 Hz)

- Small Form-factor Pluggable (SFP) transceivers

Figure 1–6 shows the bezel and front view of the FC Loop switch.
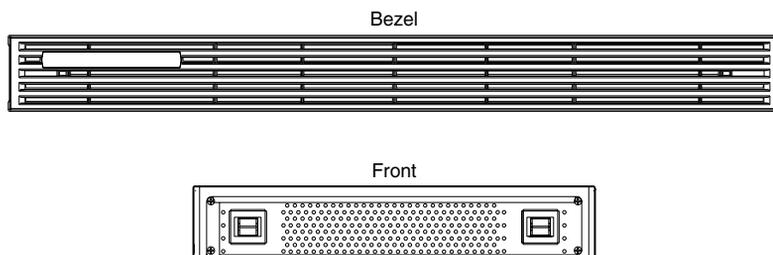
Bezel

Front

Figure 1–6: FC Loop Switch—bezel and front view

NOTE: Each bezel covers two FC Loop Switches in a space capacity of 1U. One "U" is 44.45 mm (1.75 inches) high.

HSV Controllers

Two high-performance HSV Series Controllers are contained in one rack. Each controller is contained in a separate enclosure and features:

- High-performance, PowerPC microprocessor

- An Operator Control Panel (OCP) for easy operation

- Two 2-Gbps, FC-Switch Fabric host ports

- Four 2-Gbps, FC-AL device ports

    — Arranged in redundant pairs

    — Data load/performance is balanced across a pair

    — Supports up to 240 disks (120 disks per pair)

- 1-GB cache per controller, mirrored, with battery backup

- 2-Gbps, FC cache mirroring port (with device port backups for mirroring)

The HSV Controller is the interface between the HSV Element Manager and the Enterprise storage system (the interface between hosts and disks). It is the interface to your data and performs I/O correctly and reliably. Up to 18 disk drive enclosures are supported by one HSV controller pair.

Each Enterprise controller pair consists of two HSV Controllers. Figure 1–7 shows the controllers as they sit in the storage system.

CXO7943A   CXO7944A
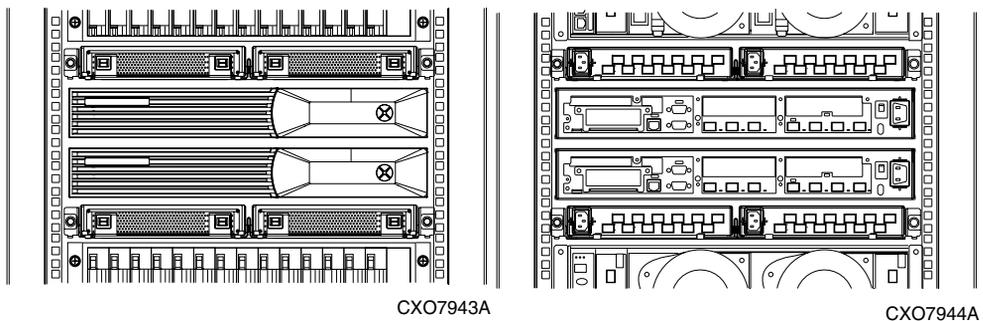
Figure 1–7: HSV Controller location—front and rear views

Enterprise Rack

The Enterprise rack provides the capability for mounting standard 483 mm (19 in) wide controllers and drive enclosures.

Two types of racks are available with your Enterprise Virtual Array:

- Enterprise 42U Rack—Available in opal with a depth of 900mm (35.4 in) with industry standard 19-in mounting rails. This rack has a space capacity of 42U.

- Enterprise 41U Rack—Available in graphite with a depth of 900mm (35.4 in) with industry standard 19-in mounting rails. This rack has a space capacity of 41U.

NOTE: Racks and rack-mountable components are typically described using "U" measurements.

The Enterprise racks provide the following:

- Unique Frame and Rail Design. Allows fast assembly, easy mounting and outstanding structural integrity.

- Thermal Integrity. Front to back natural convection cooling is greatly enhanced by the innovative multiangled design of the front door.

- Security Provisions. The front and rear door are lockable, which prevents unauthorized entry

- Flexibility. Provides easy access to hardware components for operation monitoring.

- Custom Expandability. Several options allow for quick and easy expansion of the racks to create a custom solution.

- Houses all storage system components, including:

  — Cables

  — Fibre Channel Drive Enclosures

  — Fibre Channel Loop Switches

  — HSV Controllers

  — Power Distribution Units

Figure 1–8 shows the Enterprise 42U rack.

CXO7945A
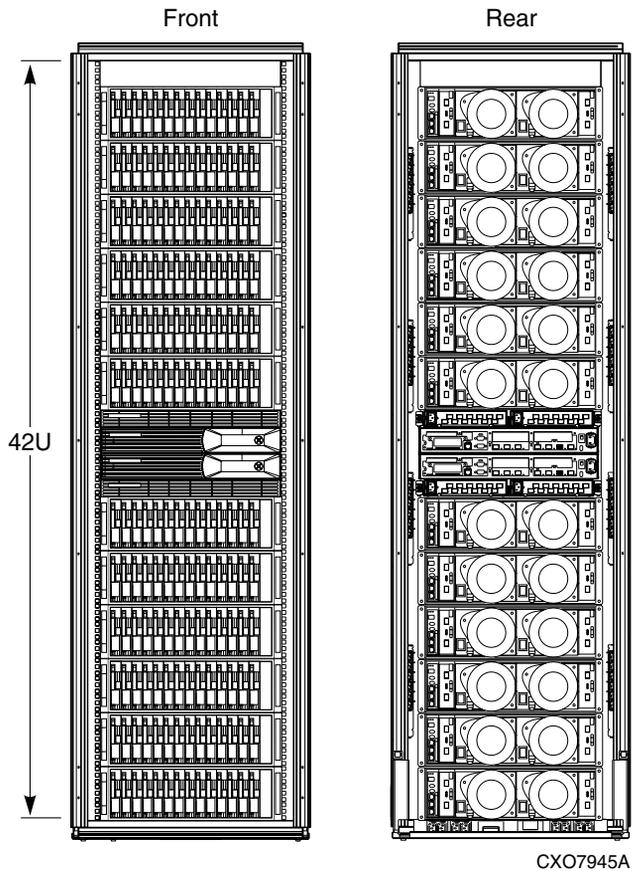
Figure 1–8: Enterprise 42U rack

Figure 1–9 shows the Enterprise 41U rack.

CXO7946A
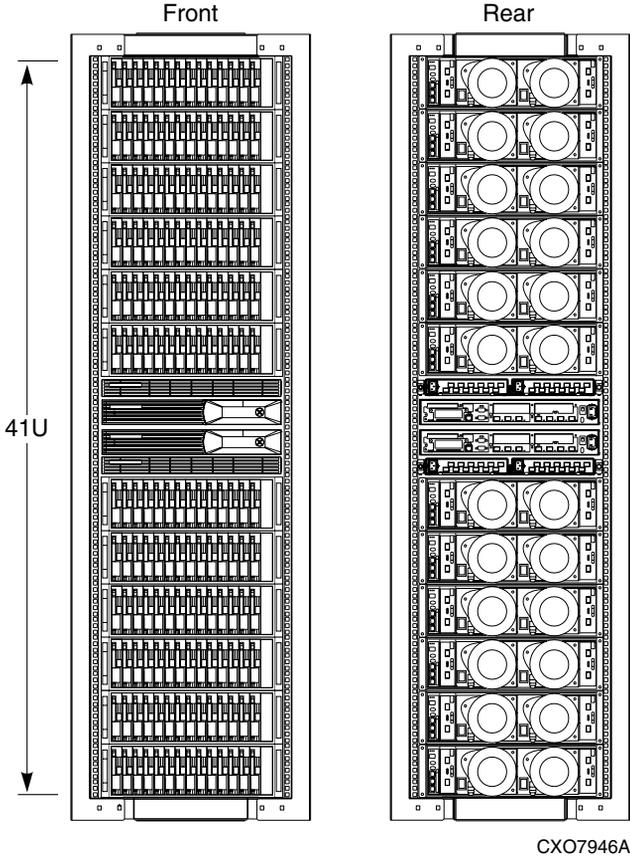
Figure 1–9: Enterprise 41U rack

2

Storage System Startup

This chapter provides the procedures necessary to continue installation and start your Enterprise Virtual Array.

This chapter consists of:

- Storage System Connections
- Procedures for Getting Started
    - — Gathering Information
    - — Obtaining a License Key
    - — Setting Up the Storage System Hardware
    - — Entering Data Using the OCP
    - — Installing the HSV Element Manager

Storage System Connections

Figure 2–1 shows how the storage system is connected to other components of the storage solution:

1. The HSV controller pair connects to two Fibre Channel fabrics, to which the hosts also connect.

2. The HSV Element Manager, which resides on the Management Appliance, also connects into the fabric.

3. The controller pair connects to FC loops, which connect to the drive enclosures. Each loop pair consists of 2 loops that run independently, but will run for the other loop if failure occurs.
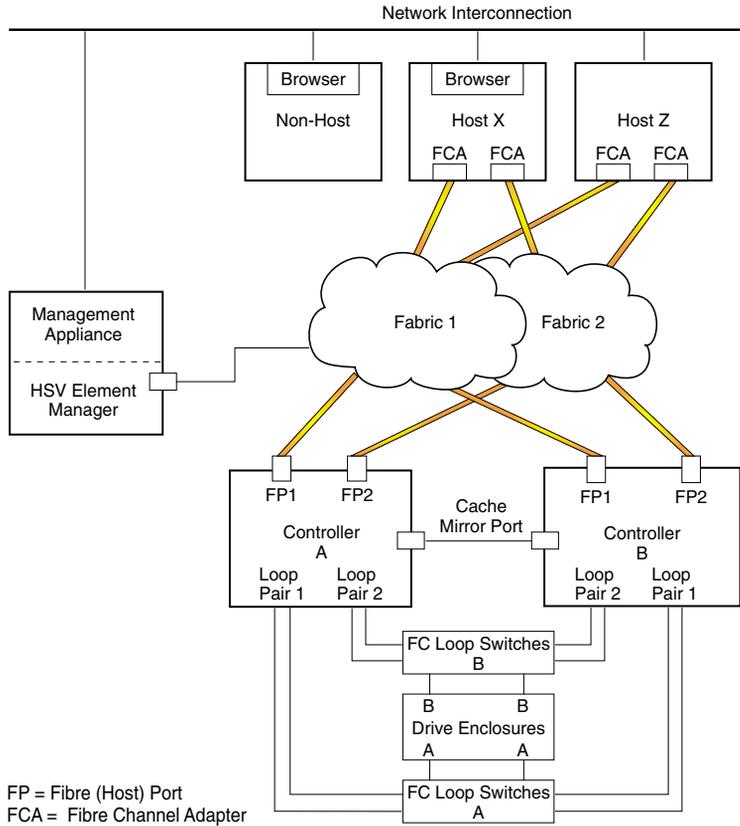
Figure 2–1: Block diagram of the storage system's connections

Procedures for Getting Started

Follow the process below to guide you through the installation of the storage system:

1. Gather information and identify all related storage system documentation.

2. Obtain a license key.

3. Contact a Compaq Authorized Service Provider for hardware configuration.

4. Enter the storage system World Wide Name (WWN) into the OCP.

5. Configure the HSV Element Manager.

6. Prepare the hosts.

7. Configure the system through the HSV Element Manager. Refer to the configuration flowchart in the HSV Element Manager's help system.

8. Make virtual disks available to their hosts. Refer to the storage system software documentation for each host's operating system.

Gathering Information

Below is important information you need to know prior to operating the Enterprise Virtual Array. Retrieve the items described below to assist you in completing initialization.

You will need to locate the following items to install the storage system:

- *StorageWorks by Compaq Enterprise Virtual Array World Wide Name Label*, which is a separate sheet of paper shipped with the system.

- *StorageWorks by Compaq Enterprise Virtual Array Read Me First* document, which is a separate sheet of paper shipped with the system.

- *SANworks by Compaq VCS License Key Retrieval Instruction Sheet*, which is a separate sheet of paper that ships in the SANworks VCS Software kit by Compaq. This sheet provides instructions for obtaining a license for the basic storage system software.

- If you bought a license for the snapshot feature, there will be another License Key Retrieval Instruction Sheet. This is a separate sheet of paper that ships in the kit called *SANworks by Compaq VCS Snapshot V1.0 for Dual HSV Controllers.*

- The latest *SANworks by Compaq Management Appliance Update*, which consists of the management appliance update CD and its associated documentation.

You can determine the latest update version available by checking your Release Notes or contacting your Compaq Authorized Service Provider to find out how to receive the latest information.

- The boxed kit for the operating system of the host computer. If there are hosts running different operating systems, you will need a boxed kit for each operating system. This kit ships separately from the storage system.

- The boxed kit that contains the hardware documentation and ships with the system. That is the box that this manual came in.

Locate these items and keep them handy. You will need them for procedures in the rest of this manual.

Host Information

Compaq recommends that you make a list of information for each computer (host) that will be used in the storage system. The information you will need for each host is as follows:

- The LAN name of the host

- A list of World Wide Names of the Fibre Channel adapters, also called host bus adapters, through which the host will connect to the fabric where the storage system resides

- IP address of each host

- Operating system type

- Available LUN numbers

Additional Documentation

The storage system documentation is divided into online help and hardcopy documentation. For complete information about all documents that pertain to the Enterprise Virtual Array and any other additional documentation that may be required to operate your storage system, see the *StorageWorks by Compaq Enterprise Virtual Array Catalog of Associated Documentation*, available at: http://www.compaq.com/products/storageworks/enterprise/documentation.html

Obtaining a License Key

A license key is necessary to unlock the VCS that runs on both controllers in a storage system. One license covers both controllers in a storage system.

Obtaining a license key requires the following documents:

- *StorageWorks by Compaq Enterprise Virtual Array World Wide Name Label.*

- *SANworks by Compaq License Key Retrieval Instruction Sheet*, which includes the License Authorization ID.

- If you purchased the snapshot license, you will also need the snapshot License Key Retrieval Instruction Sheet, which includes the License Authorization ID.

VCS License Types and WWN

There are two types of VCS licenses:

- Basic

- Snapshot

These licenses are sold as part of a software kit. Snapshot is sold based upon the snapshot capacity the customer requires.

There is one WWN per controller pair on a storage system.

IMPORTANT: Both the basic license and the WWN are required to create an initialized storage system.

Basic License

The basic license provides the right to use VCS to create and operate an initialized storage system where the Fibre Channel identity is the WWN. The WWN is generated by manufacturing and attached to the hardware. A single VCS software kit provides the basic license that covers both controllers in the storage system.

The license is bound to the WWN. The WWN is a characteristic of the entire storage system as an entity. This relationship is shown in Figure 2–2. The license and the WWN do not belong to any specific component of the storage system. Individual components can be removed and replaced—even the controllers—but the storage system remains and retains its World Wide Name identity.

Both the license and the WWN are required to create an initialized storage system.
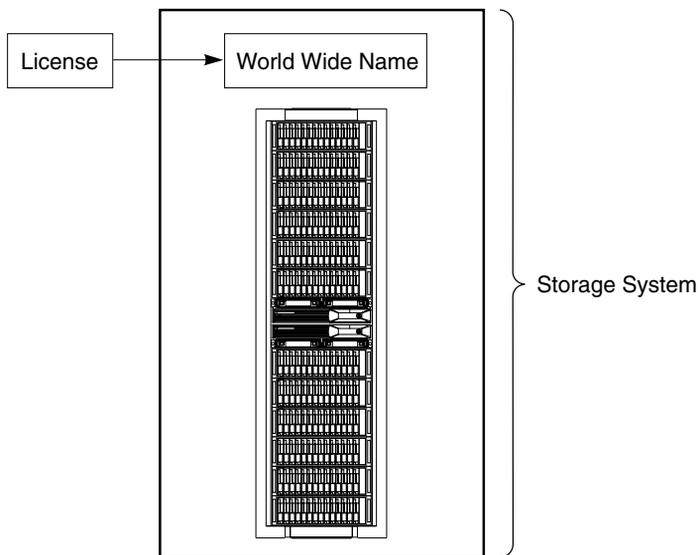
CXO7948A

Figure 2–2: Relationship of the license and the WWN to the storage system

The WWN, which is generated by manufacturing and attached to the hardware, belongs to the storage system. It is entered into the operator control panel (OCP) of one of the controllers (see page 4–41 for more information on the OCP), but it does not belong to the controllers. The controllers simply keep a record of the WWN until the storage system is initialized. At the time of initialization, the WWN becomes tied to the storage system.

The basic license must be tied to the WWN. This is done using the License Fulfillment Process described on page 2–7. You will receive an Authorization ID on a License Key Retrieval Instruction Sheet. You will provide the Authorization ID and the WWN to the license fulfillment website. The license fulfillment website will then generate and send back a license key. This license key ties the WWN to the license. When this license key is entered into the HSV Element Manager, it unlocks VCS on both controllers, and you can begin using your storage system.

Snapshot License

The snapshot license gives you the right and ability to use the value-added snapshot function. A snapshot is a fast virtual copy of a virtual disk at an instant in time. You must have the VCS basic functionality before enabling this feature.

The Snapshot license follows the same licensing scheme as the Basic License.

License Fulfillment Process

The license fulfillment process can be completed manually through email or fax, or by visiting the Compaq website.

If you have more than one license or more than one storage system, you can obtain up to 10 license keys at the same time. Each license key is locked to the WWN of one storage system, so keep records that show the association of license keys with WWNs.

Basic Licensing Process

Follow the instructions on the License Key Retrieval Instruction Sheet to obtain a license key at the license fulfillment website. If you do not have web access, the License Key Retrieval Instruction Sheet describes how to obtain a license key manually through e-mail or fax.

The license fulfillment website will prompt you to enter the storage system's WWN. This is the number that is on the *StorageWorks by Compaq Enterprise Virtual Array World Wide Name Label*. This number also may be on labels on both sides of the controllers (see Figure 2–3).

> ⚠ **CAUTION:** Enter the WWN exactly as it is on the label before you submit the licensing information. The WWN is case-sensitive and the hyphens must be entered. Once the WWN is entered into the licensing database, the license key is irrevocably locked to that WWN.
>
> Do not enter the checksum that appears on the label into the website. Doing so will invalidate the license key.

CXO7601C
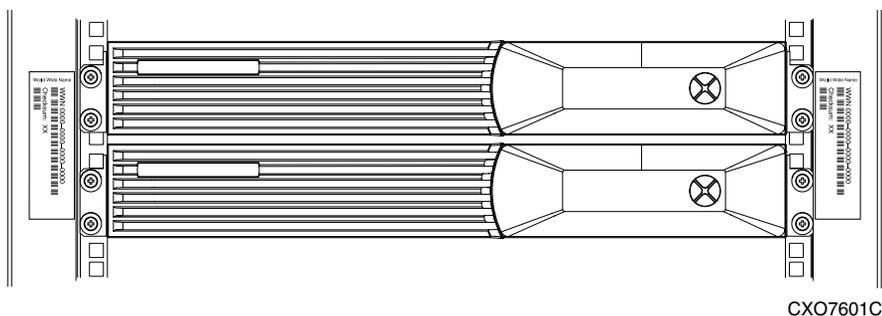
Figure 2–3: Location of the World Wide Name label

When you obtain the license key, copy it or print it. You will need to enter the license key into the HSV Element Manager (see "Installing the HSV Element Manager" on page 3–1). The license key is made up of alphanumeric characters and may have as many as 4 lines of text. Enter the license key exactly as it displays.

Snapshot Licensing Process

If you bought the snapshot feature, follow the same process as above using the snapshot License Key Retrieval Instruction Sheet.

Licensing Additional Storage Systems

If you have more than one license or more than one storage system, you can obtain up to 10 license keys at the same time. Each license key is locked to the WWN of one storage system, so keep records that show the association of license keys with WWNs.

Setting Up the Storage System Hardware

To install the storage system hardware, the following procedures must be performed by a Compaq Authorized Service Provider. Contact your service provider before proceeding.

- Complete the prerequisites
- Verify the site requirements
- Move the rack
- Stabilize the rack
- Inspect the storage system
- Install the controller cache batteries
- Apply power
- Attach the controllers to the fabric

Entering Data Using the OCP

Two pieces of data critical to initial setup must be entered into the OCP:

- WWN—mandatory to complete setup.
- Storage system password—optional. A password is a security interlock that allows only specific instances of the HSV Element Manager to access the storage system.

Setting Up an HSV-Series Controller Pair Using the OCP

Enterprise operations require that each controller pair have a unique Node WWN. This 16-character alphanumeric name identifies the system on the storage system. Compaq assigns the WWN to each storage system prior to shipment. The Enterprise Virtual Array World Wide Name Label document defines the WWN for each storage system. The Node WWN labels, similar to the one shown in Figure 2–4, specify the system-specific WWN and checksum.

CXO7545A

Figure 2–4: Sample Node WWN label

NOTE: The controller pair WWN is unique to a controller pair, and cannot be used for any other controller pair or device anywhere on the network. Figure 2–3 shows the location of the WWN label on a controller pair.

This is the only WWN applicable to any controller installed in a specific physical location, even a replacement controller.

Once a WWN is assigned to a controller, you cannot change the WWN while the controller is part of the same storage system.

Procedure for Entering the WWN

Table 2–1 defines the pushbutton functions when entering the WWN or the WWN checksum.

NOTE: The following sections describe procedures that require use of the OCP. For more information about the OCP, see Chapter 4.

Table 2–1: WWN Pushbutton Functions

	Use this pushbutton to:
▲	• Select a WWN or checksum character by scrolling up through the character list one character at a time. If you select an incorrect character, you can use either ▲ or ▼ to select the correct character.

Table 2–1: WWN Pushbutton Functions (Continued)

▶	Use this pushbutton to: • Accept the current character and select the next character. If you accept an incorrect character, you can move through all 16 characters, one character at a time, until you display the incorrect character. You can then change the character.
▼	Use this pushbutton to: • Select a WWN or checksum character by scrolling down through the character list one character at a time. If you select an incorrect character, you can use either ▲ or ▼ to the select correct character.
◀	Use this pushbutton to: • Accept all the WWN or checksum characters.

Complete the following procedure to assign the WWN to each pair of controllers.

IMPORTANT: Applying power to the rack when the controller power switches are on can prevent proper controller initialization.

The following procedure will enter the WWN 5000-1FE1-0000-0000.

NOTE: This procedure should be performed by a Compaq Authorized Service Provider.

1. Place the power switches on both controllers to the Off position.

2. Apply power to the rack.

3. On both controllers, place the power switch to On.

   NOTE: This display may not occur for up to two minutes.

   ```
   HSV110 Startup

   *******************
   ```

4. The WWN entry display has a 0 in each of the 16 positions.

   ```
   Enter WorldWide Name

   0000-0000-0000-0000
   ```
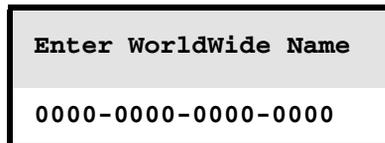
5. Press ▲ or ▼until the first character display is 5. Press ▶to accept this character and select the next.

   ```
   Enter WorldWide Name

   5000-0000-0000-0000
   ```
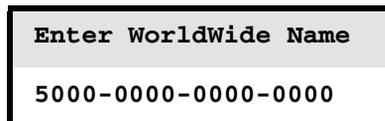
6. Repeat Step 5 to enter the remaining characters 000-1FE1-0000-0000.

```
Enter WorldWide Name

5000-1FE1-0000-0000
```

7. Press ◀ to enter the WWN and select the checksum entry mode.

```
Enter WWN Checksum

00
```

See "Procedure for Entering the WWN Checksum" on page 2–11 for details.

Procedure for Entering the WWN Checksum

The second part of the WWN entry procedure is to enter the 2-character checksum, HS, as follows.

1. Verify the initial WWN checksum displays 0 in both positions.

```
Enter WWN Checksum

00
```

2. Press ▲ or ▼ until the character H displays. Press ▶ to accept H and select the second character.

```
Enter WWN Checksum

H0
```

3. Press ▲ or ▼ until the second character displays S. Press ◀ to accept the checksum and exit.

```
Enter WWN Checksum

HS
```

4. Verify that the default display is automatically selected. This indicates the checksum is valid.

```
Storage System Name:

<No Storage System>
```

```
Node WorldWide Name:

5000-1FE1-0000-0000
```

If you enter an incorrect WWN or checksum, the system will reject the data and you must repeat the procedure.

IMPORTANT: An active (Flashing) display, an error condition, or a user entry (pressing a pushbutton) overrides the default display.

When none of these conditions exist, the default display appears after approximately 15 seconds.

Procedure for Setting the Storage System Password

The eight-character, alphanumeric storage system password feature enables you to restrict certain functions to selected Element Managers. Table 2–2 describes the pushbutton functions when using the password feature.

Table 2–2: System Password Pushbutton Functions

▲	Use this pushbutton to: • Select a password character by scrolling up through the character list one character at a time. If you select an incorrect character, you can use ▼ to select the correct character.
▶	Use this pushbutton to: • Move from the default display to the system menu tree. • Move from the system password display to the password entry display. • Accept the current character and select the next character. If you accept an incorrect character, you can loop through the display, one position at time, to select the character to be changed.
▼	Use this pushbutton to: • Select a password character by scrolling down through the character list one character at a time. If you select an incorrect character, you can use ▲ to the select correct character.
◀	Use this pushbutton to: • Accept all the password characters.

Complete the following procedure to set the password using the pushbuttons as described in Table 2–2. This procedure will enter JWMFZJJP as the password.

1. Determine a unique, eight-character password using uppercase or lowercase letters A through Z.

2. With either of the default menus (Storage System Name or Node World Wide Name) displayed, press any pushbutton to select the menu tree.

3. Press ▼ to cycle through the displays until System Password is active (Flashing).

   Press ▶ to select the system password function.

   ```
   Shutdown System

   System Password
   ```

4. When the System Password function is Flashing, press ▶ to select the change password function.

   The default Enter Password function displays the default password, AAAAAAAA.

   ```
   Change

   Clear

   Enter Password

   AAAAAAAA
   ```

5. Enter the first character of the new password by pressing the ▲ or ▼ until J displays.

6. Press ▶ to accept this character and select the next character.

7. Repeat the process to enter the remaining password characters, WMFZJJP.

   ```
   Enter Password

   JWMFZJJP
   ```

8. Press ◀ twice to enter the password and return to the default menu display.

   ```
   Storage System Name:

   <No Storage System>
   ```

   ```
   Node WorldWide Name:

   5000-1FE1-0000-0000
   ```

The controller pair setup is complete.

Installing the HSV Element Manager

This step may be skipped if you have the latest version of the HSV Element Manager already running on the Management Appliance.

If you need to install a new version, locate the Management Appliance update CD and the associated documentation. Refer to "Additional Documentation" on page 2–4. Follow the instructions in the Management Appliance Update Installation Card to install the new software.

3

HSV Element Manager

This chapter provides information about operating the HSV Element Manager.

This chapter consists of:

- Introduction to the HSV Element Manager
- Installing the HSV Element Manager
- Launching the HSV Element Manager
- Organization of the Interface Window
    — The Session Pane
    — The Navigation Pane
    — The Content Pane
- Setting Management Agent Options
- Controlling and Monitoring Storage System Components
    — Virtual Disks
    — Hosts
    — Disk Groups
    — Hardware

Introduction to the HSV Element Manager

The HSV Element Manager is the user interface through which you communicate with your Enterprise Virtual Array via the HSV controllers.

The client of the management agent is a standard web browser. The relationship of the HSV Element Manager and a storage system is shown in Figure 1–2 on page 1–4.

The HSV Element Manager consists of:

• The GUI that displays the usage of the storage system.

• The software behind the GUI, which controls and monitors the functions.

The HSV Element Manager software is installed on a SAN Management Appliance and runs in the environment provided by Open SAN Manager (OSM). When installed on the management appliance, the software is called an HSV management agent, as shown in Figure 3–1.

The HSV Element Manager is launched through OSM, using the OSM interface.

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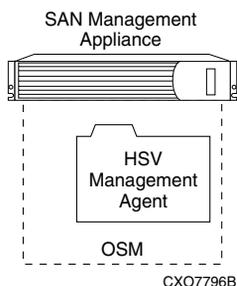
Figure 3–1: Management Appliance, OSM, and HSV Management Agent Relationship

The management agent contains a very extensive online help system that describes procedures to follow and presents detailed information on each page that the management agent contains.

Installing the HSV Element Manager

The HSV Element Manager is installed on the SAN Management Appliance and runs in the OSM environment. This step may be skipped if the latest version of the HSV Element Manager is running on the SAN Management Appliance. Verify the latest version at the Compaq website: http://www.compaq.com.

To install a new version, locate the management appliance update CD-ROM and the associated documentation that was shipped with your storage system. Follow the instructions in the CD-ROM documentation to install the new software.

You will also need a supported browser on the same network as the management appliance. This network can be anything from a LAN to the Internet. The documentation that comes with the update CD-ROM contains information on which versions of which browsers are supported.

When the new software is installed, follow the CD-ROM documentation to get to OSM, the launching point for the HSV Element Manager. Follow the instructions on the OSM online help to navigate to and launch the HSV Element Manager.

Launching the HSV Element Manager

The HSV Element Manager is launched through the OSM software, using the OSM browser interface, as shown in Figure 3–2.
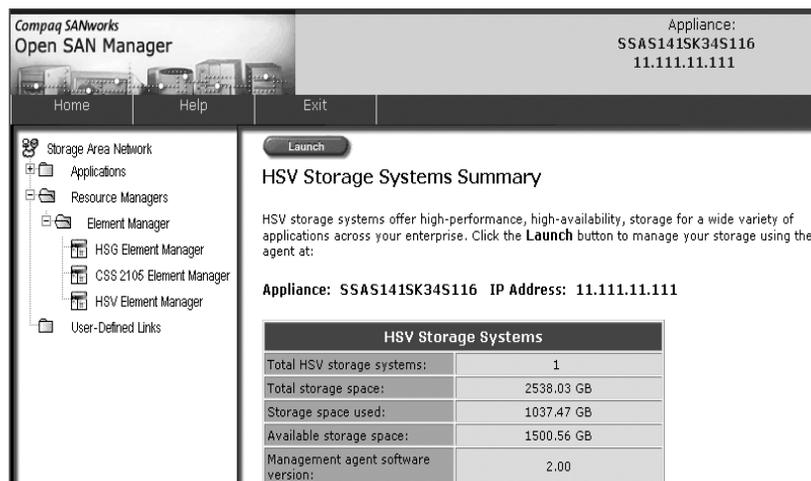
Figure 3–2: OSM Browser Interface

To launch the HSV Element Manager from OSM:

1. In the Navigation pane (left frame), open folders as follows:
   Resource Managers > Element Manager > HSV Element Manager
   The HSV Storage System Summary Page will display in the Content pane, as
   shown in Figure 3–2.

2. Click **Launch** at the top of the HSV Storage System Summary Page.
   The HSV Element Manager launches in a new window as shown in Figure 3–3.

NOTE: You can also launch the HSV Element Manager directly from the **Resource Managers**
folder in the Navigation pane.
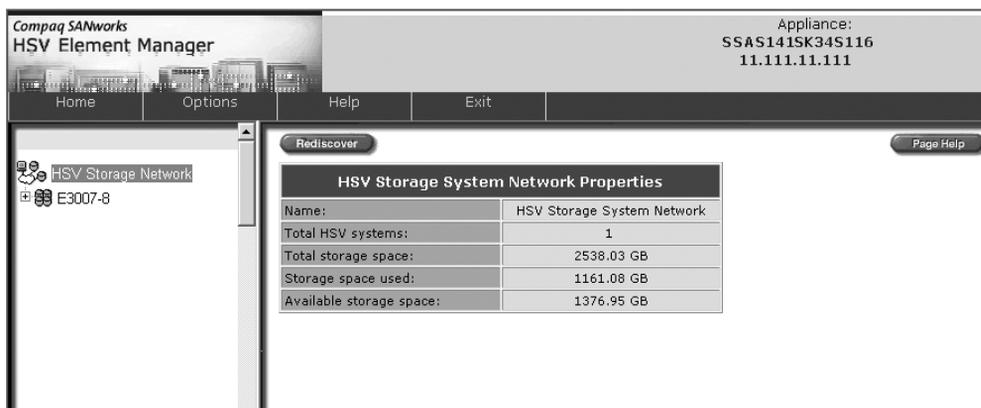
Figure 3–3: HSV Storage System Summary Page

Organization of the Interface Window

The HSV Element Manager user interface is organized like the OSM interface. There
are three panes in the window, as shown in Figure 3–4:

• Session pane

• Navigation pane

• Content pane
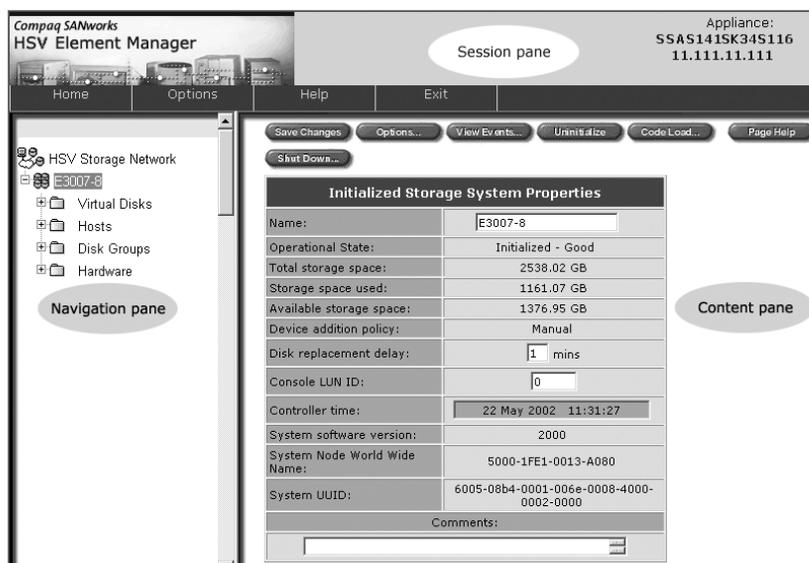
Figure 3–4: The three panes of the Interface Window

The Session Pane

The Session pane, shown in Figure 3–5, displays information about the specific management agent you are using:

1. The SANworks software component you are using (the HSV Element Manager).

2. The name and IP address of the SAN Management Appliance that is running the management agent you are using.

3. Buttons that control management agent operations. They are:

   - **Home**–displays the HSV Element Manager home page

   - **Options**–selects interface and agent options

   - **Help**–displays online help in a new window

   - **Exit**–exits the HSV Element Manager and returns to OSM

Figure 3–5: The Session pane

The Navigation Pane

The Navigation pane, shown in Figure 3–6, is a hierarchy of folders that organize components that represent the logical structure of the storage system. These logical structures, which are examined further in "Controlling and Monitoring Storage System Components," on page 3–9 are:

- Virtual disks

- Hosts

- Disk groups

- Hardware

The folder structure is a familiar paradigm and working with folders is easy.

NOTE: Multiple storage systems can be controlled and displayed under the HSV Storage Network.
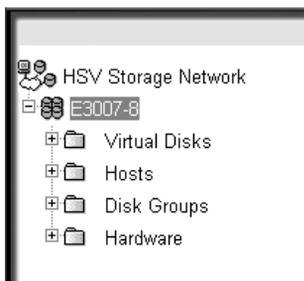
Figure 3–6: The Navigation pane

Adding a Folder

The initial folder structure is simple, but you can add layers of subfolders to customize the organization of the various components. For example, to group a number of hosts into a category, click on the top level host folder and add a subfolder in which to group those hosts.

NOTE: Folders may only be created within the virtual disks and hosts folders.

Navigating Through Folders

You can "drill down" into any folder for more specific information. For example, to locate information on a specific virtual disk, start at the top-level virtual disk folder and click on the subfolders until you locate the virtual disk in question.

NOTE: Click a folder's **+** symbol to expand it without updating the Content pane for quicker access to subcomponents.

The Content Pane

The Content pane, shown in Figure 3–7, displays information on the object you selected in the Navigation pane and presents control actions you can perform.

The **Page Help** button, which is in the upper right corner of the Content pane page, displays help for that page and is an entry point into the entire help system.
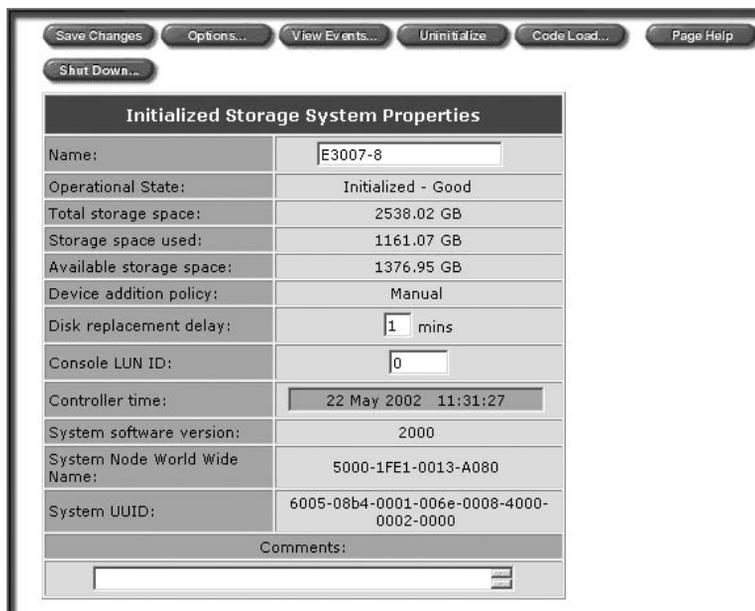
Figure 3–7: The Content pane

Setting Management Agent Options

Each installation of the HSV Element Manager is a management agent. Management agent options are settings that affect the actions, attributes, and appearance of the management agent.

To access the option pages, click the **Options** button on the Session pane, as shown in Figure 3–8.
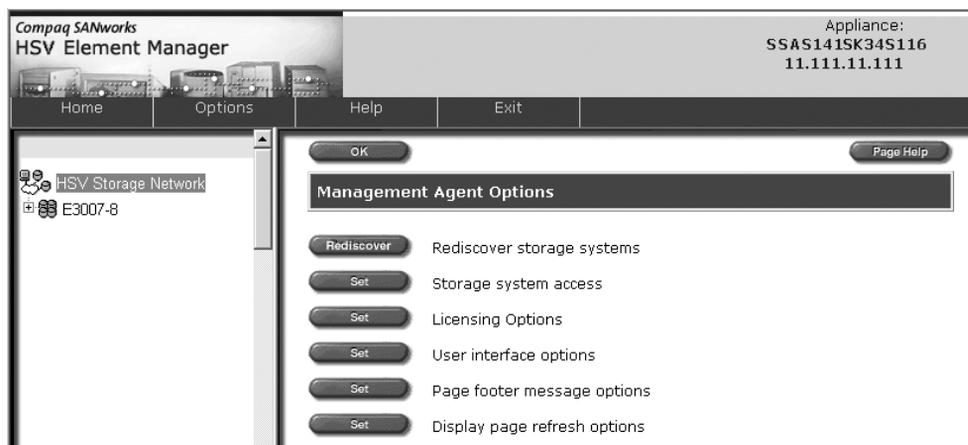
Figure 3–8: Options button on the Session pane

The agent options available are shown in Table 3–1.

Table 3–1: Agent Options

Option	Description
Rediscover storage systems	Instruct the management agent to look for new storage systems on the fabric.
Storage system access	Establish a password interlock between the management agent and individual storage systems.
Licensing options	Add or display software license keys.
User interface options	Establish how the interface looks and acts in specific instances.
Page footer message options	Set a message that will appear at the bottom of each Content pane page.
Display refresh	The display refresh option enables the agent to periodically check the status of displayed attributes and displays a refreshed page when updated.

For more information on a specific option, log into the HSV Element Manager and click the **Page Help** button on the page for that option.

Controlling and Monitoring Storage System Components

This section discusses controlling and monitoring storage system components. The components that you can control using the HSV Element Manager are:

- Virtual Disks

- Hosts

- Disk Groups

- Hardware

All of these components are accessible using the folders in the Navigation pane.
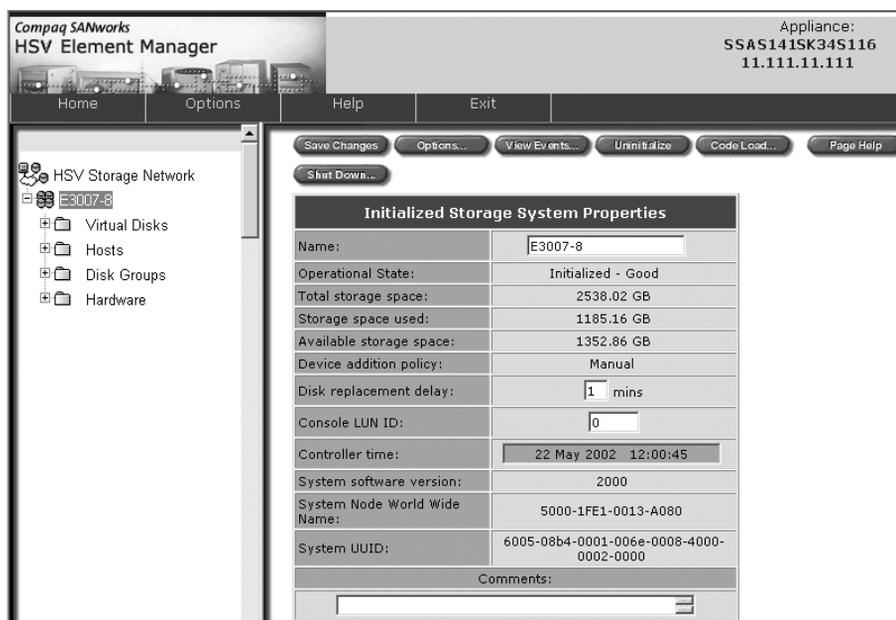
Figure 3–9: Storage system components

Virtual Disks

A virtual disk is a simulated disk drive created by the controllers as storage for one or more hosts. Virtual disk characteristics provide a specific combination of capacity, availability, performance, and accessibility. The controller pair simulates these characteristics by deploying the disk group specified for the virtual disk.

The host computer sees the virtual disk as "real," exactly like it would see a physical disk with the same characteristics.

NOTE: The maximum number of virtual disks is 512. One virtual disk can be presented to multiple hosts. The maximum size of a virtual disk is 2047 GB. The maximum number of total presentation is 8192 GB.

There are three types of virtual disks:

- Active member of a virtual disk family—a virtual disk that it is accessed by one or more hosts for storage. An active member of a virtual disk family is automatically created whenever a new virtual disk family is created. An active virtual disk member and its snapshot, if they exist, constitute a virtual disk family.

- Snapshot virtual disk—a virtual disk that reflects the contents of another virtual disk at a particular point in time. A snapshot operation can only be done to an active member of a virtual disk family. The active virtual disk member and its snapshots constitute a virtual disk family. A snapshot is intended to be temporary.

NOTE: A maximum of 7 snapshots per virtual disk can exist at one time.

- Virtual disk Snapclone—a Virtually Instantaneous Snapclone is a virtual disk that is an exact copy of another virtual disk at a particular point in time. Only an active member of a virtual disk family can be snapcloned. The Snapclone, like a snapshot, reflects the contents of the source virtual disk at a particular point in time. Unlike the snapshot, the Snapclone is an actual clone of the source virtual disk and becomes an independent active virtual disk member of its own disk family when all the data is replicated.

Within the Virtual Disk Folder in the Navigation pane are virtual disk families. You can click on any one of the virtual disk families within the Virtual Disk Folder to see the properties page for a specific virtual disk family.

The Virtual Disk Folder is accessible using the folder structure in the Navigation pane, as shown in Figure 3–10.
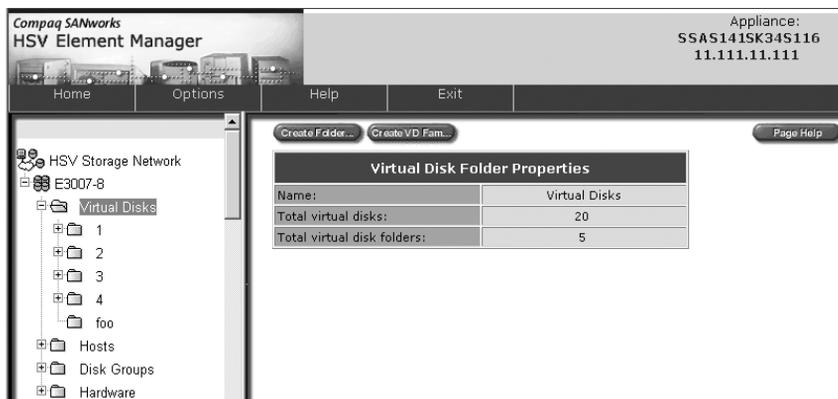
Figure 3–10: Virtual Disk Folder

Hosts

A host is a computer that operates applications relative to a storage system. A host uses one or more virtual disks that are created and presented by the controller pair. Each host connects to the fabric through one or more Fibre Channel adapters (FCAs). An FCA is a hardware and software device that enables a host computer to use the Fibre Channel transmission protocol. Each Fibre Channel port on a host adapter has a World Wide Name (WWN). Typically, the host operating system will report the WWNs of all the FCA ports in the host. The WWN also appears on a sticker on the FCA board.

The Host Folder is accessible using the folder structure in the Navigation pane, as shown in Figure 3–11.
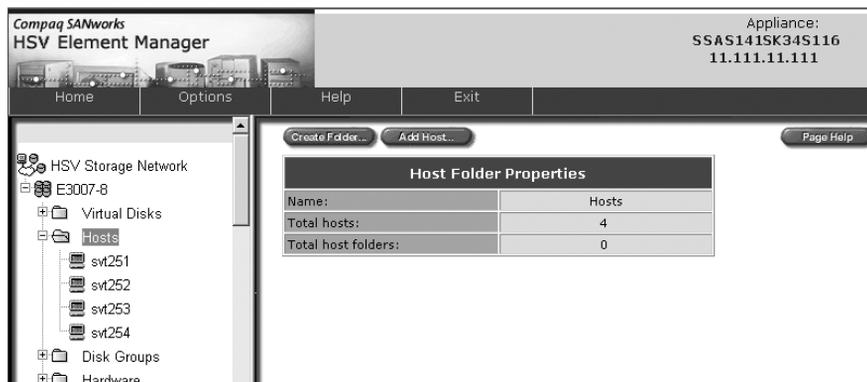
Figure 3–11: Host Folder

Adding a Host

Before a host can use the storage system's virtual disks, the host must be known to the storage system. This process is called "adding a host." Adding a host creates a path from the storage system to one host FCA. Additional host FCAs can be specified as a modification to the host properties.

Deleting a Host

Deleting a host removes it from the list of hosts that the storage system maintains. You can not delete a host if there are any virtual disks presented to it.

NOTE: The only changes that you can perform on a host are adding and deleting a host FCA. For any other changes, you must delete the host, then add it again with the desired changes.

Modifying Host Properties

Changes can only be made to the following host properties.

- Operating System

- Virtual Disk/LUN

- Comments

NOTE: For any other changes, the host must be deleted and added again.

Working with Ports

The Port options available from the Host Properties page lets you modify the host adapters. A host adapter, or host bus adapter, is a hardware device that is installed in a host computer and enables the host to use the Fibre Channel transmission protocol. Many upper level protocols can be used with Fibre Channel.

Presenting a Host

A host can be selected for presentation (a virtual disk made available to a host). Two choices exist:

- Select a host for presentation—indicates that the host can use the virtual disk for data storage. The host will see the virtual disk at the next available LUN.

- Select a host and LUN for presentation—indicates that the host can use this virtual disk for data storage. The host will see the virtual disk at the specified LUN.

NOTE: When you select a host for a virtual disk, the disk is available to the host as it becomes a "host client" of the virtual disk. The term "host" is also used for SNMP-enabled hosts, which is any computer configured to receive event information from the storage system.

Disk Groups

A disk group is the set or pool of physical disk drives in which a virtual disk is created. The physical disk is a disk drive that plugs into an enclosure slot and communicates to the controllers through the device-side Fibre Channel loops. Only the controllers can communicate directly with the physical disks.

Collectively, the physical disks are called the array and constitute the storage pool from which the controllers create virtual disks. One controller pair can support up to 240 physical disks.

The following information is true about disk groups:

- Each physical disk drive belongs to only one disk group.

- Multiple virtual disks can be created in one disk group, up to the disk group's capacity.

- Each virtual disk exists entirely within one disk group.

- A disk group can contain all the physical disk drives in a controller pair's array or it may contain a subset of the array.

- The minimum number of disks in a disk group is eight.

One disk group (the default) is created when the system is initialized. Disk groups can be added as needed.

NOTE: The default disk group is the first disk group created when the storage system is initialized. This disk group can contain the entire set of physical disks in the array, or just a few disks. The minimum number of physical disks the default disk group can contain is eight.

All the virtual disks in the disk group are created across the capacity of the disk group. The Default Disk Group is accessible using the folder structure in the Navigation pane, as shown in Figure 3–12.
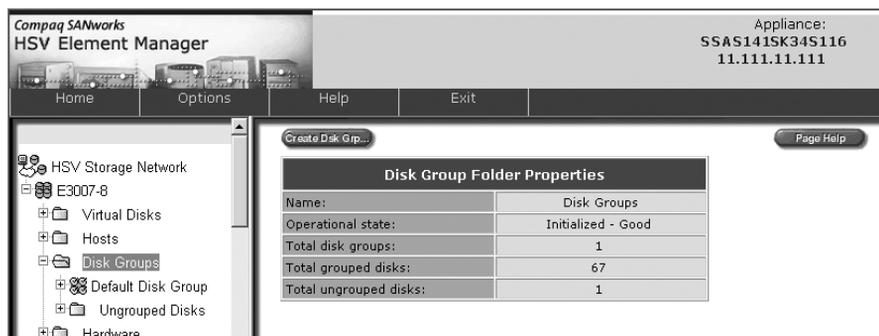
Figure 3–12: Top level disk group

Working with Disk Groups

A disk group is the set or pool of physical disk drives in which a virtual disk is created. The operations you can perform to a disk group are:

- Creating a disk group—combines physical disk drives into one disk group, using disk drives from as many disk enclosures as possible.

- Modifying a disk group—changes disk group properties, including the disk failure protection level, occupancy alarm level, disk group name, or comments.

- Adding a new disk to a disk group—adds a new physical disk to a disk group in the storage system.

- Deleting a disk group—deletes a physical disk from a disk group. Deleting a disk group consists of freeing all physical drives contained in that disk group. It cannot be done unless there are no virtual disks existing in that disk group.

- Ungroup—Removes the disk from a disk group if already a member.

For more information about disk drives, see "Fibre Channel Disk Drives" on page 4–8.

Hardware

The hardware folders provide a view into the operation of various physical components of the storage system:

- Rack—a floor-standing structure primarily designed for, and capable of, holding and supporting storage system equipment.

- Controllers—a hardware and firmware device that manages communications between host systems and other devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support.

- Enclosures

  — Drive enclosure—contains up to 14 physical disk drives and their supporting structures.

  — Controller enclosure—a mechanical enclosure that provides power and cooling to the installed controller module electronics.

- Physical Disk Drives—a disk drive that plugs into an enclosure slot and communicates with the controllers through device-side Fibre Channel loops.

NOTE: The FC Loop switches are not recognized by the HSV Element Manager.

The Hardware Folder is accessible using the folder structure in the Navigation pane, as shown in Figure 3–13.

Figure 3–13: Hardware Folders

Enterprise Storage System Racks

The rack (objects) folder is located within the Hardware folder and is accessible using the folder structure in the Navigation pane, as shown in Figure 3–14.
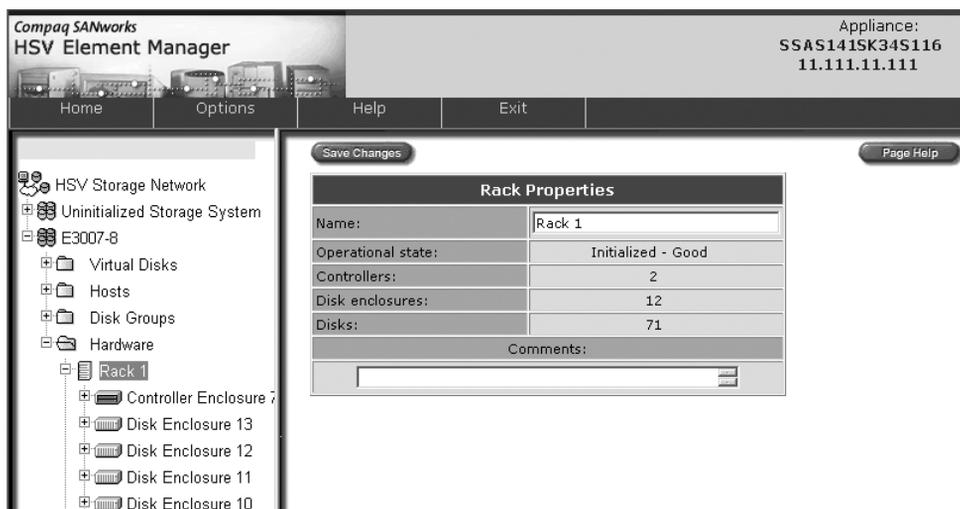
Figure 3–14: Rack Folder

For more information about Enterprise racks, see "Enterprise Racks" on page 4–57.

HSV Controllers

Each Enterprise Storage System has a pair of HSV Controllers. The Controller properties can be viewed by expanding the Controller Enclosure, then selecting Controller A or Controller B. The following properties are available for each controller:

- General—Identifies the general properties of the controller. These properties include identification, condition and state, cache memory, and location information.

- Host Ports—Identifies the WWN, operational state, speed, and switch connection for each host port.

- Device Ports—Identifies the WWN, loop ID, and operational state for each loop pair.

- Enclosure—Identifies the location, blowers, power, temperature and cache battery system information.

The Controller enclosure and controller objects are accessible using the folder structure in the Navigation pane, as shown in Figure 3–15.

Figure 3–15: HSV Controller Folder

For more information about HSV Controllers, see "HSV Controllers" on page 4–41.

Enclosures

Two types of hardware enclosures exist for the Enterprise Virtual Array, disk (drive) enclosures and controller enclosures.

- Disk Enclosure—a disk enclosure contains up to 14 physical disk drives and their supporting structures. Each of the vertical positions in the enclosure where the disk drive is located is called a bay. The bays are numbered sequentially in decimal numbers, starting at the left when you are facing the front of the rack.

- Controller Enclosure—a controller enclosure is the mechanical enclosure that protects the controller circuit board and its associated components. Except for the cache batteries and blower assemblies, all components in the controller enclosure are considered one assembly and must not be separated.

The Disk Enclosure object is accessible using the folder structure in the Navigation pane, as shown in Figure 3–16.

Figure 3–16: Disk Enclosures Folder

The Controller Enclosure object is accessible using the folder structure in the Navigation pane, as shown in Figure 3–17.
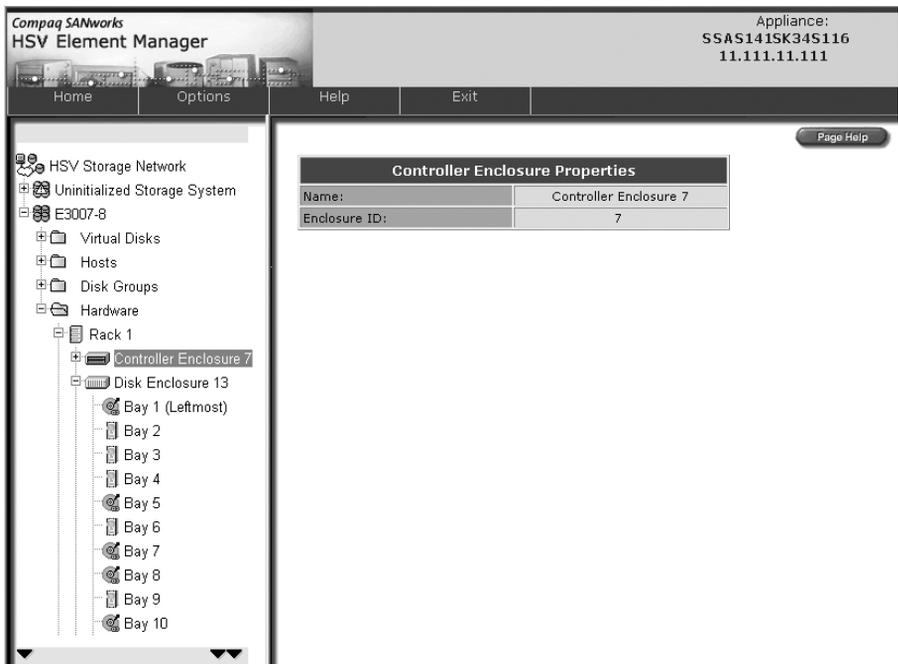
Figure 3–17: Enclosures Folder and Properties Page

For more information about enclosures, see "Fibre Channel Drive Enclosures" and "HSV Controllers" on page 4–41.

4

Storage System Hardware Components

This chapter describes the Enterprise hardware components. This chapter consists of:

- Fibre Channel Drive Enclosures
  - — Enclosure Layout
  - — FC-AL I/O Modules
  - — Fiber Optic Cables
  - — Fibre Channel Disk Drives
  - — Power and Cooling Components
  - — Disk Drive Enclosure EMU
  - — Verifying Enclosure Operation
  - — Status Monitoring and Display
- Fibre Channel Loop Switches
  - — Power-On Self Test
  - — Reading the Switch LEDs
  - — Problem Isolation
- HSV Controllers
  - — High Availability Features
  - — Operator Control Panel
  - — HSV Controller Cabling
- Enterprise Racks
  - — Rack Configurations
  - — Power Distribution
  - — Moving and Stabilizing a Rack

Fibre Channel Drive Enclosures

The major components of the enclosure are:

- 2.125-Gb, dual loop, 14-drive enclosure.

- Dual-loop, FC-AL I/O modules and cable components that are the interface between the drives and the host controllers.

- Fibre Optic cables.

- Fibre Channel disk drives and drive blanks.

- Power and cooling components that include power supplies, cords, and blowers.

- EMU that monitors the operation of the enclosure and the elements while displaying element status. When the EMU detects a condition that could affect operation, it generates a local alarm and reports the condition to the controller.

Enclosure Layout

The disk drives mount in the bays in the front of the enclosure (see Figure 4–1). These bays are numbered from the left (bay ❶) to the right. A drive is referred to by the bay number. The drive in bay ❶ is drive 1, the drive in bay ❽ is drive 8. The enclosure status icons are located in the lower-right, front corner ❺.
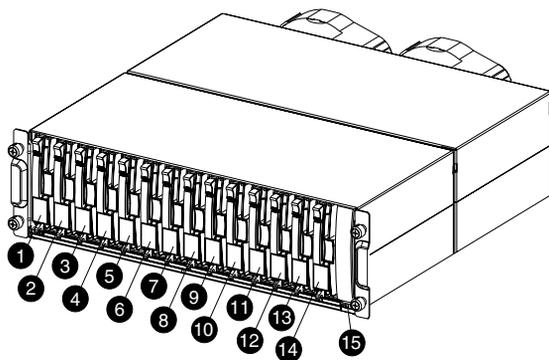
❶ to ⓮   Drive bays
⓯   Enclosure status icons

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Figure 4–1: Drive enclosure—front view

Figure 4–2 shows the rear view of the Fibre Channel drive enclosure.

- ❶ EMU
- ❷ I/O module B
- ❸ Blower 1
- ❹ Power supply 1
- ❺ Blower 2
- ❻ Power supply 2
- ❼ I/O module A

CXO7950A
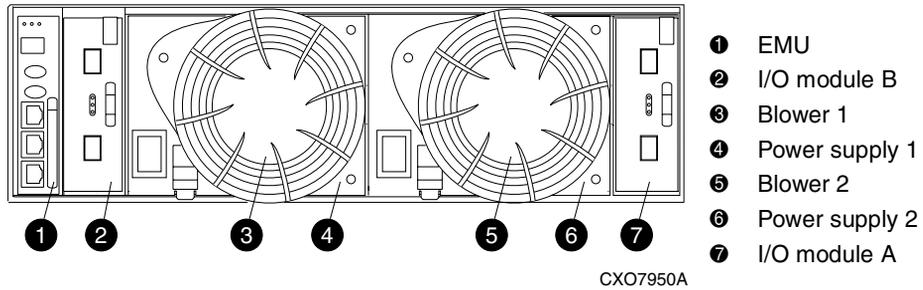
Figure 4–2: Drive enclosure—rear view

NOTE: The Enterprise Storage System Fibre Channel implementation uses a low-power laser transceiver or gigabit interface converter (GBIC) that does not damage the human eye.

FC-AL I/O Modules

Two I/O modules (see Figure 4–3 and Figure 4–4) are the interface between the drive enclosure elements and the host controller. They route data to and from the drives using Loop A and Loop B, the dual-loop configuration.
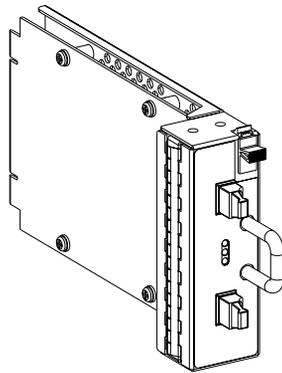
Figure 4–3: I/O module B　　　　**Figure 4–4: I/O module A**
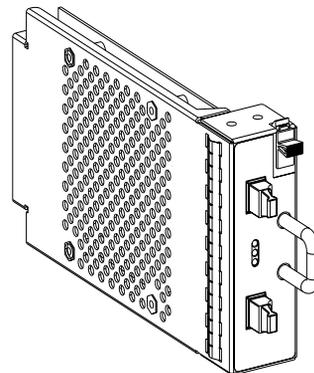
Enterprise only supports dual-controller, dual-loop operation. Each controller is connected to both the I/O module A and I/O module B in each drive enclosure.

The A and B I/O modules are similar in appearance and function in the same manner, but they *are not* interchangeable. The physical differences between the modules ensure that you can install only:

- The A module (❶) at the right end of the enclosure, behind drive bay 1.

- The B module (❷) at the left end of the enclosure, next to the EMU.

❶   I/O module A
❷   I/O module B

CXO7951A
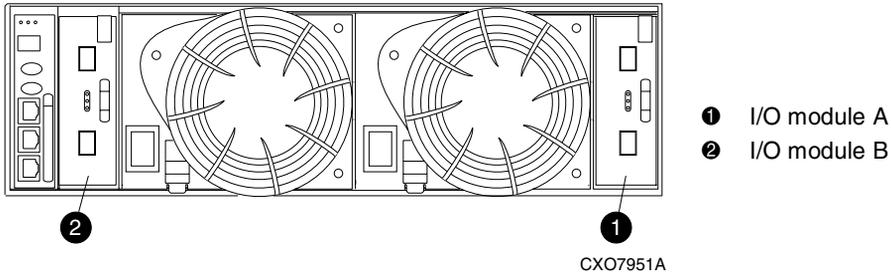
Figure 4–5: I/O module locations

The I/O modules are major components in the Fibre Channel loop. Each module has two ports that can both transmit and receive data or bidirectional operation. Activating a port requires connecting a transceiver to the port via fiber optic cables. The port function depends upon the loop (see Figure 4–6).

❶   Loop A bottom port
❷   Loop A top port
❸   Loop B bottom port
❹   Loop B top port

CXO7954A
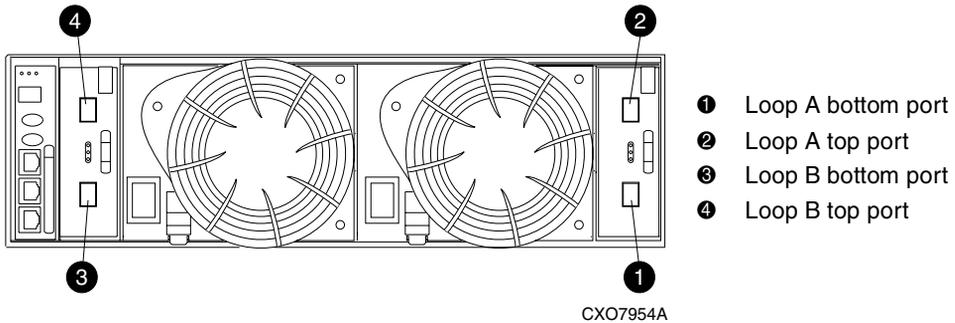
Figure 4–6: Input and output ports

I/O Module Status Displays

The three green LEDs on the A and B I/O modules display the status (see Figure 4–7). The LED status displays for an operational I/O module are shown in Table 4–1. Table 4–2 shows the status displays for a nonoperational I/O module.

❶   Top port status LED
❷   Power status LED
❸   Bottom port status LED

CXO7488A
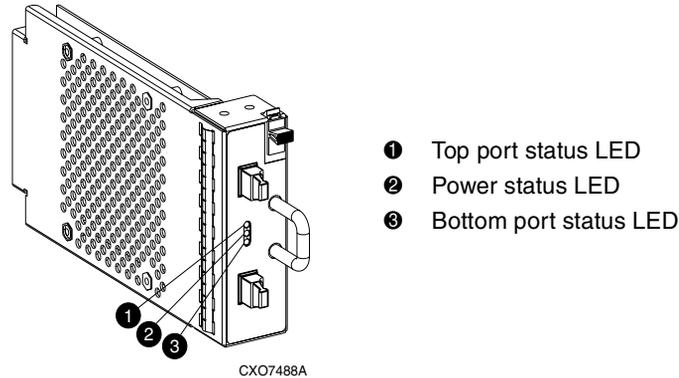
Figure 4–7: I/O module status LEDs

Table 4–1: Operational I/O Module LED Descriptions and Status Displays

○	Off
●	On
☀	Flashing
●	Top Port—FC-AL signal detected.
☀	Power—Flashes for one minute. The LED is On constantly; Bottom Port—FC-AL signal detected.
●	This display can occur during *the first minute after* initial power application.
●	Top Port—FC-AL signal detected.
●	Power—Present.
●	Bottom Port—FC-AL signal detected. This display can occur *one minute after* the initial application of power.
☀	When the locate function is active all three LEDs flash in synchronization.
☀	The locate function overrides all other LED functions. Therefore, an error may exist.
☀	

Table 4–2: Nonoperational I/O Module Status Displays

● ● ◯	Top Port—FC-AL signal detected. Power—Present (After one minute the power LED will be On constantly). Bottom Port—No FC-AL signal detected. Check transceiver and fiber cable connections. **NOTE:** This status is also displayed when connected to a FC Loop switch.
◯ ● ●	Top Port—No FC-AL signal detected. Check transceiver and fiber cable connections. Power—Present. Bottom Port—FC-AL signal detected.
☀ ● ●	Top Port—EMU detected possible transceiver problem. Check transceiver and fiber cable connections. Power—Present. Bottom Port—FC-AL signal detected.
● ● ☀	Top Port—FC-AL signal detected. Power—Present. Bottom Port—EMU detected possible transceiver problem. Check transceiver and fiber cable connections.
◯ ◯ ◯	No I/O module power. I/O module is nonoperational. Check power supplies. If power supplies are operational, replace I/O module.

I/O Module Power

The I/O module +5 VDC power sensing device protects the modules against overcurrent conditions. If the +5 VDC current exceeds 2.5 A rms (nominal), the sensor opens, removing the +5 VDC input from the I/O module, thereby disabling the module until:

- The defective I/O module is replaced.

- The overcurrent condition no longer exists.

NOTE: A disabled I/O module cannot transfer data and disconnects all the drives in the enclosure from the loop.

Fiber Optic Cables

The Enterprise Storage System Fibre Channel implementation uses orange, 50-µm, multimode, fiber optic cables. Figure 4–8 shows the Fibre Optic cable assembly, which consists of two, 2-m Fiber Optic strands and Small Form-factor connectors on each end.

CXO7972A

Figure 4–8: 2-Gb Fiber Optic components

To ensure optimum operation, the fiber optic components (that is, the transceivers, the fiber optic cable connectors, and the fiber within the cable) require protection from contamination and mechanical hazards. Failure to provide this protection can reduce the amount of light passing through a component, thereby degrading operation. Actions that can avoid degradation include:

- To avoid breaking the fiber within the cable, do not:
  - Kink the cable.
  - Use a cable bend-radius of less than 30 mm (1.18 in).
- To avoid deforming, or possibly breaking the fiber within the cable, do not place heavy objects on the cable.
- To avoid contaminating the optical connectors:
  - Do not touch the connectors.
  - Never leave the connectors exposed to the air.
  - Install a dust cover on each transceiver and fiber cable connector when they are disconnected.

If an open connector is exposed to dust, or there is any doubt about the cleanliness of the connector, clean the connector as described in "Protecting Fiber Optic Connections" on page D–5.

Fibre Channel Disk Drives

Compaq Universal disk drives are hot-pluggable and include the following features:

- Dual-ported 2 Gbps FC-AL interface that allows up to 120 drives to be supported per FC-AL pair.

- 36 GB and 72 GB, 10K and 15K rpm, and additional drives as certified by Compaq.

- Compact, direct-connect design for maximum storage density and increased reliability and signal integrity.

- Improved drive cooling essential for high performance.

- Better vibration damping for improved performance.

- Greater component commonality throughout the Enterprise Virtual Array.

Up to 14 disk drives can be contained in a Fibre Channel Drive Enclosure. Figure 4–9 shows the front view of a Fibre Channel disk drive.
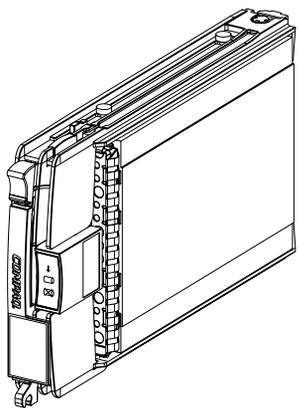
CXO6695A

Figure 4–9: Compaq hot-pluggable Fibre Channel disk drive

The Compaq-supplied disk drives conform to the enclosure initiated Enclosure Services Interface (ESI).

> △ **CAUTION:** Controlling air flow within the enclosure requires installing a drive or a drive blank in each drive bay. To avoid overheating, never remove more than one drive or drive blank from an operating enclosure at the same time. To prevent overheating and ensure proper operation, Compaq recommends installing a drive of equal or greater capacity, or a drive blank, as soon as possible.

Drive Status Reporting

The three status icons (see Figure 4–10) on the front of each drive define the drive operational status. The LEDs that illuminate these icons are located on the enclosure backplane. To determine the drive status, you must observe the icons described in the following sections.
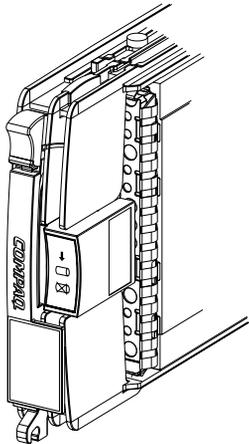
CXO7167A

Figure 4–10: Drive icons

The following sections describe the purpose of each of the icons.

Table 4–3: Disk drive icon descriptions

Drive Ready	This green LED is a "drive ready" indicator and is On when the drive is idle.
	NOTE: For SCSI disk drives that were used in previous products, this indicator was Off when the drive was idle.
Drive On-line	The green LED for this icon is controlled by the disk drive. The LED may be Off when:
	• There is no controller on the bus.
	• +5.1 VDC is not available.
	• The drive is not properly installed in the enclosure.
Drive Failure	The amber LED flashes in synchronization with the other two LEDs in response to the EMU locate command.
	Depending on the host controller, the LED for this icon can flash when the controller detects an error condition.

Drive Status Displays

The two green and one amber LEDs are either On, Off, or Flashing. In some configurations, the host controller can control the status LEDs. The operational drive LED status displays are shown in Table 4–4. See Table 4–5 for the nonoperational drive status LED displays.

Table 4–4: Operational Drive Status Displays

Initial Start Up
This LED flashes (at medium speed).
This LED is On.
This LED is Off.

Drive Not Accessed
The operational drive is not being accessed.

Drive Locate Function
This LED flashes (at high speed).
This LED flashes (at medium speed).
This LED is On.

Drive Operational and Active
This LED flashes.
This LED is On.
This LED is Off.
NOTE: The drive is configured as part of an array. DO NOT replace an active drive.

Table 4–5: Nonoperational Drive Status Displays

	Drive Is Nonoperational
	All LEDs are On. Indicates no connection or the controllers are offline. **Recommended Corrective Actions:** 1.Check power supplies for proper operation. 2.Replace if defective. 3.Replace drive.
	Drive Error/Not Active
	This LED is On. This LED is Off. This LED is Flashing **Recommended Corrective Actions:** 1.Verify drive loop continuity. 2.Replace drive.

Drive Power

The drive voltage backplane sensors (+5.1 VDC and +12.1 VDC) can detect a drive overcurrent condition. When a drive overcurrent condition exists, the sensor disconnects the voltage from the drive to prevent writing data to the drive. The drive is disabled until one of the following conditions occurs:

- The defective drive is replaced.

- The overcurrent condition no longer exists.

Drive Blank

To maintain the proper enclosure air flow, you must have a drive or a drive blank in each drive bay. The function of the drive blanks (see Figure 4–11) is to control air flow within a bay.

CXO6824A
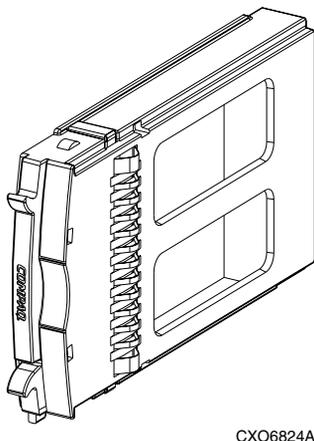
Figure 4–11: Drive blank

Replacing a Disk or Drive Blank

To replace a disk, you must complete the procedures outlined in Appendix D.

The disk replacement kit contains detailed replacement instructions.

> △ **CAUTION:** Never remove more than one drive at a time, as this process can cause the enclosure to overheat.
> To prevent overheating and ensure proper operation, install a drive of equal or greater capacity, or a drive blank, as soon as possible.

NOTE: For the latest information and instructions about Compaq FC hard drives, such as compatibility and installation instructions, refer to "About this Guide" on page xv.

Power and Cooling Components

This section describes the function and general operation of the enclosure power supplies and blowers. Figure 4–12 identifies the major power supply assembly components.

❶	Power supply assembly
❷	Power supply and blower status LED
❸	AC Input connector with bail
❹	Module latch (port-wine colored)
❺	Blower tabs (port-wine colored)
❻	Blower element

CXO7489A
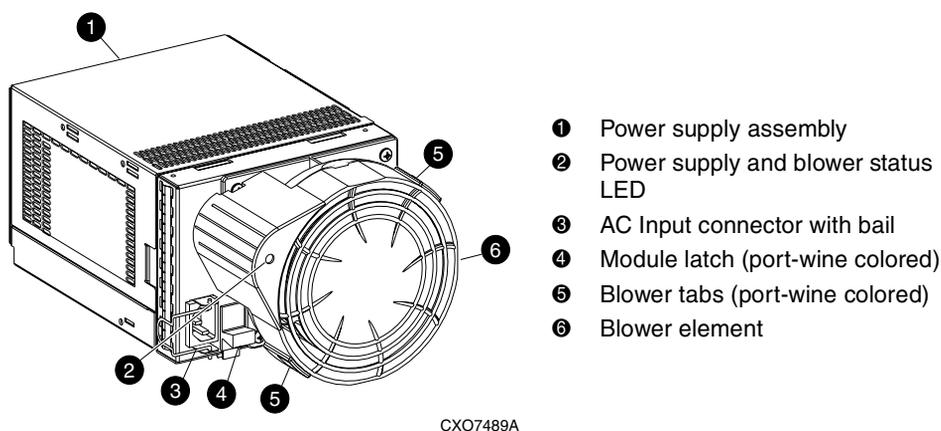
Figure 4–12: Power supply and blower assembly components

Enclosure Power

The two power supplies mount in the rear of the enclosure. The supplies are auto-ranging and operate on a country-specific AC input voltage of 202 to 240 VAC ±10%, 50 to 60 Hz, ±5%, (188 to 264 VAC, 47 to 63 Hz).

The DC outputs of this power supply are:

• +5.1 VDC for the EMU, I/O module, backplane, and drives

• +12.1 VDC for the drives

• +12.5 VDC for the blower

The nominal output of each power supply is 499 W, with a peak output of 681 W. A single power supply can support an enclosure with a full complement of disks, blowers, EMU, and I/O module.

The power supply circuitry provides protection against:

• Overloads

• Short circuits

• Overheating

Power supply status and diagnostic information is reported to the EMU with voltage, current, and temperature signals.

See Appendix A for the enclosure power specifications.

Temperature Sensing

The power supply temperature sensor provides a temperature range signal to the EMU. The EMU can use this signal to set the blower speed.

The power supply internal temperature can also set the speed of the blower. The higher the power supply temperature, the faster the speed of the blower. Should the power supply temperature exceed a preset value, the power supply automatically shuts down.

Blowers

The blower mounts on the rear of the power supply. A power supply connector is the interface between the blower and the enclosure for:

- Blower speed control to the blower

- Blower speed to the EMU through the power supply

- Power supply high speed enable

- Blower operating voltage

The power-supply-mounted blowers cool the enclosure by circulating air through the enclosure and the elements. The rate at which air moves (the air flow) determines the amount of cooling and is a function of blower speed (rpm). These blowers, under the control of the EMU or the associated power supply, can operate at multiple speeds. This ensures that when the enclosure temperature changes the blowers can automatically adjust the air flow.

Should a blower be operating too slowly or stopped (a "blower failure"), internal circuitry automatically causes the operational blower to operate at a higher speed. Simultaneously, the error condition is reported to you in several ways, including the power supply LED, the audible alarm, the enclosure fault LEDs, and the EMU alphanumeric display.

Should both blowers fail, the power supplies automatically shutdown.

NOTE: The failure of a power supply +12.5 VDC circuit disables the associated blower.

Power Supply and Blower Status Reporting

The green status LED on the blower displays the status of both the power supply and the blower. See Table 4–6 for definitions of the LED displays.

Table 4–6: Power Supply and Blower Status LED Displays

When the blower and the power supply are operational, the display may be:
● Both the power supply and the blower are operational.
☀ Either the power supply or the blower locate function is active.
When the blower or the power supply is nonoperational, the display is:
○ Either the power supply or the blower is nonoperational. When there is a blower problem, the other blower runs at a higher speed.
Recommended Corrective Actions
1.Check blower for proper operation. Replace if defective.
Check power supplies for proper operation. Replace if defective.

Disk Drive Enclosure EMU

The EMU provides increased protection against catastrophic failures. The EMU communicates with the HSV Controller to detect conditions such as failed power supplies, failed blowers, elevated temperatures, and external air sense faults.

Figure 4–13 shows the Drive Enclosure EMU as a standalone unit.

CXO6697A
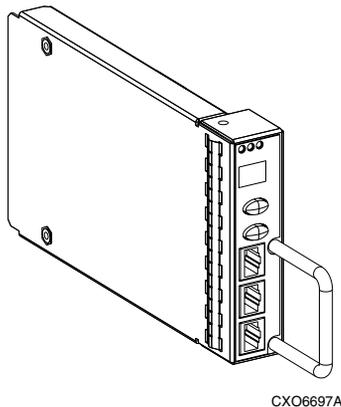
Figure 4–13: Drive Enclosure EMU

The EMU for Fibre Channel-Arbitrated Loop (FC–AL) drive enclosures is fully compliant with SCSI-3 Enclosure Services (SES), and mounts in the left rear bay of a drive enclosure (see ❶, Figure).

❶ EMU
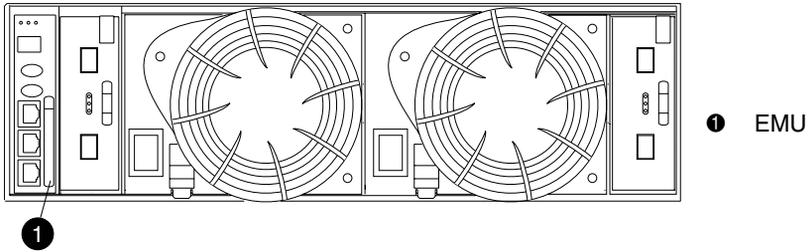
Figure 4–14: EMU location

Controls and Displays

See Figure 4–15 for definition of the EMU displays, controls, and connectors.
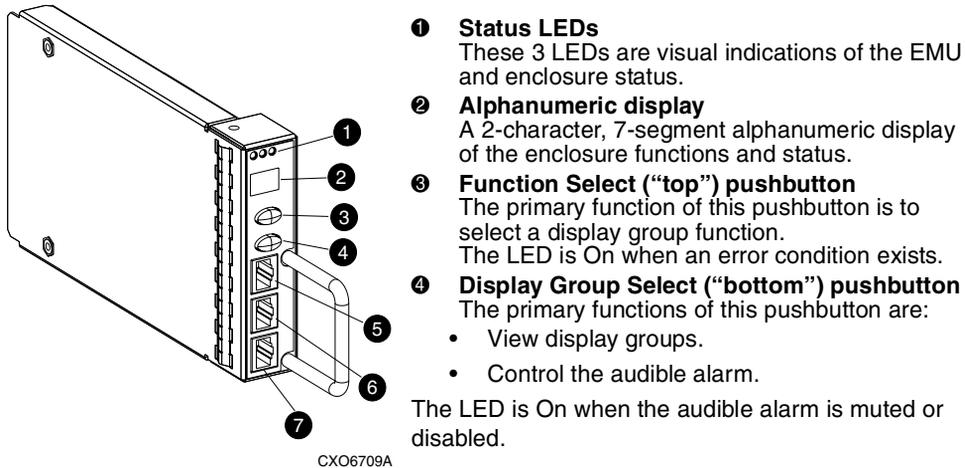
❶ **Status LEDs**
These 3 LEDs are visual indications of the EMU and enclosure status.

❷ **Alphanumeric display**
A 2-character, 7-segment alphanumeric display of the enclosure functions and status.

❸ **Function Select ("top") pushbutton**
The primary function of this pushbutton is to select a display group function.
The LED is On when an error condition exists.

❹ **Display Group Select ("bottom") pushbutton**
The primary functions of this pushbutton are:

- View display groups.
- Control the audible alarm.

The LED is On when the audible alarm is muted or disabled.

CXO6709A

❺ **RS232 ONLY**—A keyed, RJ45-type connector for use by Compaq Authorized Service Providers.

❻ **LCD ONLY**—An unused RJ45-type connector.

❼ **CAB ONLY**—A keyed, RJ45-type enclosure address bus connector.

> **WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into the "RS232 ONLY" receptacle.**

Figure 4–15: EMU controls and displays

EMU Functions

The primary functions of the EMU include:

- Using the Enclosure Services Processor (ESP) to control the Enclosure Services Interface (ESI) and communicate with the controllers.

- Assigning the Enclosure Number (En), based upon the cabinet address bus feature.

- Displaying the bay 1 loop ID.

- Monitoring enclosure operation.

- Detecting, reporting, recording, and displaying conditions.

- Displaying EMU, enclosure, and element status.

- Implementing automatic corrective actions for some conditions.

- Providing enclosure status data to the controllers.

- Reporting the WWN and the logical address of all drives.

IMPORTANT: Although the EMU can determine the logical address of a drive, the EMU can neither display nor change this information. The HSV Element Manager GUI can display the addresses from the EMU-supplied status information.

EMU Monitoring Functions

The internal EMU circuitry monitors the enclosure and element functions listed in Table 4–7.

Table 4–7: EMU Monitoring Functions

Element	Monitored Functions	
Blowers	• Installation • Removal	• Type • Speed (rpm)
Drives	• Installation • Removal • Bypass status	• Loop ID • Temperature • Drive fault
EMU	• Temperature • Operation	• Type • Revision level
Enclosure	• Enclosure power • Enclosure fault	• Backplane type • Backplane revision level

Table 4–7: EMU Monitoring Functions (Continued)

Element	Monitored Functions	
I/O Module	• Installation • Removal • Status	• Type • Revision Level
Power Supplies	• Installation • Removal • Status • Type • Revision level	• +5 V DC voltage and current • +12 V DC voltage and current • Total power • Temperature
Transceiver	• Type	• Link status

EMU Displays

The EMU uses a combination of LEDs, icons, the two-character alphanumeric display, and an audible alarm to indicate the operational status of the enclosure and the enclosure elements (see Table 4–8).

Table 4–8: EMU Status Indicators

Indicator	Function
Audible Alarm[1]	Any EMU detected condition causes this indicator to sound.
EMU Icons[2] 	The EMU LEDs above the icons display the enclosure and EMU status.
Alphanumeric Display[3]	The 2-character, 7-segment display can display alpha-numeric characters.

1. For information about the audible alarm, see "Enclosure and Element Conditions" on page 4–29.
2. For a description of the LED functions, see "EMU LED Displays" on page 4–19.
3. For a description of the alphanumeric display functions, see "Using the Alphanumeric Display" on page 4–21.

EMU LED Displays

The EMU status LEDs are arranged horizontally above the alphanumeric display (see Figure 4–16). These icons are the same as those on the front, lower right corner of the enclosure. When the EMU and the enclosure are operational the LEDs, from left to right, are Flashing, On, and Off.
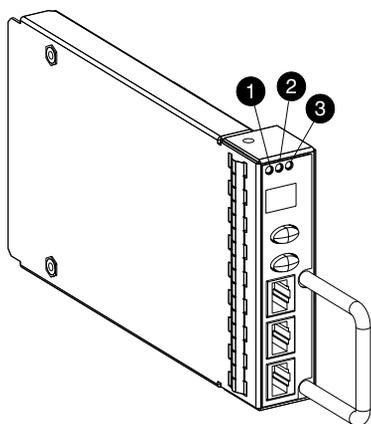
CXO6819A

❶ **EMU Status LED**

This Flashing green LED is the "heartbeat" for an operational EMU.

❷ **Enclosure Power Status LED**

This green LED is On when both the +5 V DC and +12 V DC are correct.

❸ **Enclosure Fault LED**

This amber LED is normally Off. The LED is On when an enclosure error condition exits.

Figure 4–16: EMU Status LEDs

You can determine the EMU and enclosure status by analyzing the EMU LED displays in Table 4–9.

Table 4–9: EMU LED Displays

EMU LED Green	Power LED Green	Fault LED Amber	Status and Recommended Actions
Flashing	Flashing	Flashing	The EMU locate function is active. This display has precedence over all others. Fault conditions cannot be displayed when the locate function is active.
Flashing	On	Off	The EMU is operational. The enclosure power (both +5 V DC and +12 V DC) is present and correct. There are NO enclosure faults.

Table 4–9: EMU LED Displays (Continued)

EMU LED Green	Power LED Green	Fault LED Amber	Status and Recommended Actions
Flashing	On	On	The EMU is operational. There is an enclosure fault. Check the alphanumeric display error code for detailed information about the problem.
Flashing	Off	Off	The EMU is operational. This display may be present when power is initially applied to the enclosure. **NOTE:** When the +5 VDC is incorrect, all the LEDs are Off.
On	On	Off	There is an EMU fault There is no enclosure fault.
Off	On	Off	There is an EMU fault There is no enclosure fault.
Off	Off	Off	There is an enclosure fault. Either +5 VDC is incorrect, or both +5 VDC and +12 VDC are incorrect. Other error conditions may exist.

Using the Alphanumeric Display

The two-character alphanumeric display is located at the top of the EMU (see ❶, Figure 4–17). This 7-segment display that provides information about multiple enclosure functions. The pushbuttons control the data displayed or entered.

CXO7373A

❶ Alphanumeric display
❷ Function select (top pushbutton)
❸ Display Group select (bottom pushbutton)
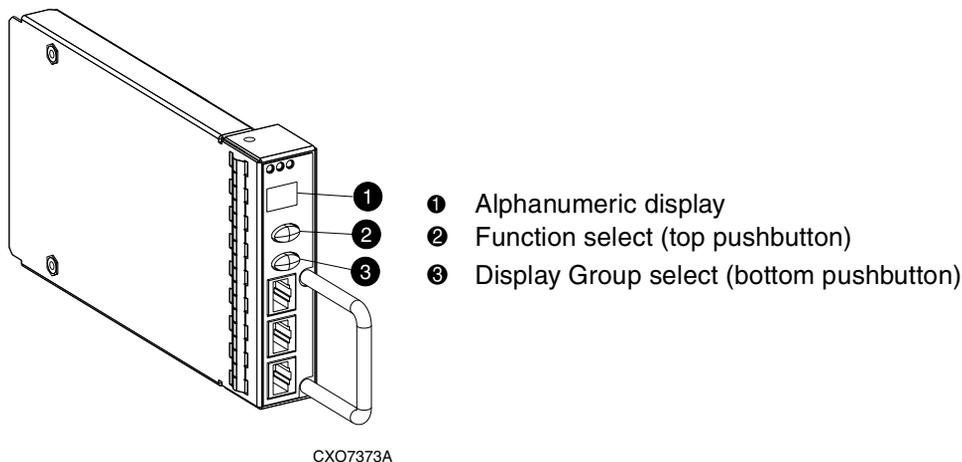
Figure 4–17: Alphanumeric display and controls

IMPORTANT: 7-segment display limitations preclude displaying uppercase characters *B*, *K*, *M*, *N*, *Q*, *R*, *S*, *T*, *V*, *W*, *X*, *Y*, or *Z*, or the lowercase characters *a*, *e*, *f*, *g*, *j*, *k*, *l*, *m*, *p*, *q*, *s*, *t*, *v*, *w*, *x*, *y*, or *z*. The lowercase characters *b*, *c*, *d*, *h*, *i*, *o*, *r*, and *u* displays are similar to the actual characters.

Alphanumeric Display Description

The top-level, two-character alphanumeric display (*En*, *Li*, *rG*, *Au,* and *Er*), is the display group. The function of the other displays is display-group dependent. The default display is the En, a decimal number in the range *00* through *14*. The pushbuttons allow you to select the alphanumeric display or to enter data.

- The bottom pushbutton *(*see ❸*,* Figure 4–17) enables you to sequentially move between groups and to select a display group.

  See Table 4–10 for a description of these display groups.

- The top pushbutton, (see ❷, Figure 4–17) enables you to move between the levels within a display group.

Display Groups

When you press and release the bottom pushbutton, the alphanumeric display selects a different display group. Table 4–10 describes the display groups.

Table 4–10: EMU Display Groups

Display	Display Group	Description
En	Enclosure Number	The enclosure number is the default display and is a decimal number in the range *00* through *14*. See "Using the Enclosure Number Feature," on page 4–26 for detailed information.
Li	Bay 1 Loop ID	This display group has a single sublevel display that defines the enclosure bay 1 loop ID. Valid loop IDs are in the range *00* through *7F.*
rG	Reporting Group	This display group has two, 2-digit displays that define the reporting group number in the range *0000* through *4095.*
Au	Audible Alarm	This display group provides control over the audible alarm or horn. The sublevel displays are audible alarm enabled (*on*) or audible alarm disabled (*oF*). See "Enclosure and Element Conditions," on page 4–29 for detailed information.
Er	Error Condition	This display group reads Er when there is an error condition. See "Enclosure and Element Conditions," on page 4–29 for detailed information.

IMPORTANT: Anytime you press and release the bottom pushbutton (see ❸, Figure 4–17), the display will change to *En*, *Li*, *rG*, *Au,* or *Er.*

A Flashing alphanumeric display indicates that you can edit an address, state, or view a condition report.

EMU Pushbutton LEDs

The pushbutton LEDs define error conditions and the state of the audible alarm.

- When an error condition exists, the top pushbutton LED is On.
  - For a single error condition, the LED is On until it is viewed
  - For multiple errors, the LED is On until the most recent error condition is viewed.

The bottom pushbutton LED is On only when the alarm is muted or disabled.

Audible Alarm Operations

Whenever an error condition exists, the audible alarm automatically sounds until all errors are corrected. You have the option of either muting or disabling the alarm. Using these options establish the following conditions:

- A disabled audible alarm *cannot sound*.

- Even when muted, *any new condition* causes the alarm to sound.

Audible Alarm Patterns

The duration and number of times the audible alarm sounds, the sound pattern, is a function of the error condition type. See Table 4–11 for the duration and the approximate relationship of these alarms.The most severe, active error condition controls the alarm pattern.

Table 4–11: Audible Alarm Sound Patterns

Condition Type	Cycle 1	Cycle 2
UNRECOVERABLE	████████	████████
CRITICAL	██ ██ ██	██ ██ ██
NONCRITICAL	██ ██	██ ██
INFORMATION	██	██

Legend ██ Alarm On ☐ Alarm Off

Some element manager GUIs can place the alarm in the "remind" state. In this state, the alarm sounds the most severe active error condition sound pattern at approximately 30-second intervals.

NOTE: The HSV Element Manager cannot implement the remind function.

Controlling the Audible Alarm

You can control the alarm with the pushbuttons. This process includes muting, enabling, and disabling. When an error condition exists, the alphanumeric display reads *Er*, the alarm sounds, and you can:

- Correct all errors, thereby silencing the alarm until a new error occurs.

- "Mute," or *temporarily* disable, the alarm by pressing and holding the bottom pushbutton. The alarm remains Off until another error occurs, or until you enable ("unmute") the alarm. When a *new* error occurs, the alarm sounds and the pushbutton LED is Off.

  Using the mute feature ensures that you are aware of the more severe errors and provides you with the capability of correcting them promptly.

- Disable the alarm to prevent any error condition from sounding the alarm.

IMPORTANT: Disabling the alarm does not prevent the EMU alphanumeric display from displaying Er. Nor does it prevent the HSV Element Manager from displaying the error condition report.

When the alarm is enabled (*on*), the bottom pushbutton LED is Off.

How to Enable the Audible Alarm

Complete the following procedure to enable the alarm.

1. Press and release the bottom pushbutton until the alphanumeric display is *Au*.

2. Press and hold the top pushbutton until the alphanumeric display is a Flashing *oF* (Audible Alarm Off).

IMPORTANT: When the alarm display is *flashing*, pressing and holding the top pushbutton causes the display to rapidly change between *on* and *oF*. Pressing and releasing the top pushbutton causes the display to select the next state.

3. Press and release the top pushbutton to change the display to a Flashing *on* (Audible Alarm On).

4. Press and release the bottom pushbutton to accept the change and to display *Au*. The bottom pushbutton LED is now Off.

How to Mute or Unmute the Audible Alarm

When there is an error condition, determine one of the following:

- The error does not require immediate corrective action.
- You cannot implement a correction (such as, you require a replacement element).

You can mute the audible alarm by completing the following procedure.

NOTE: *Er* will be displayed in the alphanumeric display when an error condition is present.

1. Press and hold the bottom pushbutton until the LED is On.

   A muted alarm will remain Off until a new condition report exists.

2. To unmute the alarm, press and hold the bottom pushbutton until the LED is Off. When a new error condition occurs, the alarm will sound.

How to Disable the Audible Alarm

Disabling the audible alarm affects only one enclosure. This action does not affect condition report displays on the EMU alphanumeric display or the HSV Element Manager GUI.

Complete the following procedure to disable the alarm:

1. Press and release the bottom pushbutton until the alphanumeric display is *Au*.

2. Press and hold the top pushbutton until the alphanumeric display is a Flashing *on* (Audible Alarm On).

IMPORTANT: When the alarm display is Flashing, pressing and holding the top pushbutton causes the display to rapidly change between *on* and *oF*.
Pressing and releasing the top pushbutton causes the display to select the next state.

3. Press and release the top pushbutton to change the display to a Flashing *oF* (Audible Alarm Off).

4. Press and release the bottom pushbutton to accept the change and display *Au*. The bottom pushbutton LED is now On.

IMPORTANT: A disabled audible alarm (the bottom pushbutton LED is On) cannot sound for any error condition. All errors will be displayed on the HSV Element Manager GUI and the EMU alphanumeric display.
Compaq recommends that rather than disabling the audible alarm, you use the mute function (see "How to Mute or Unmute the Audible Alarm" on page 4–25).
When you use the disable function, you should enable the audible alarm as soon as possible (see "How to Enable the Audible Alarm" on page 4–24).

Using the Enclosure Number Feature

This section provides a general description of the purpose, function, and operation of the EMU enclosure number (En) feature.

En Description

In a single rack configuration, the En is a decimal number in the range *00* through *14,* which is automatically assigned by the enclosure address bus.

NOTE: Your storage system may use an enclosure address bus higher than *14* if your Enterprise supports an optional expansion cabinet.

By default, the two-character alphanumeric display shows this number. Pressing the bottom pushbutton changes the display to *En*, the En display mode.

When the display is *En*, pressing and releasing the top pushbutton displays the En.

A display of *00* indicates that the enclosure is not connected to the enclosure address bus. When this condition exists, there is no EMU-to-EMU communication over the enclosure address bus. This configuration is known as "just-a-bunch-of-disks," or a JBOD configuration.

A display of *01* through *14* indicates that the enclosure is physically connected to the enclosure address bus and can exchange information with other enclosures on the enclosure address bus. The decimal number indicates the physical position of the enclosure in relation to the bottom of the rack.

- *01* is the address of the enclosure connected to the bottom connector in the first (bottom) junction box (JB).

- *14* is the address of the enclosure closest to end of the bus, the top connector in the last (upper) JB.

IMPORTANT: The enclosure address bus connection determines the *En*.

For a single rack, the display is a decimal number in the range *01* through *14*. For a multiple (two) rack configuration, the display is decimal number in the range *01* through *24*.

For JBOD configurations the enclosure *En* display is always *00*. You can only display, never change the *En* value.

Unless there is an error condition, the display automatically returns to the En (*01* through *14*) one minute after a pushbutton was last pressed.

Enclosure Address Bus

The enclosure address bus is composed of cables and JBs that interconnects the drive enclosures and controller enclosures to provide a means for managing and reporting environmental conditions within the cabinet. The EMUs collect the data for the associated enclosure.

The drive enclosure numbers are always assigned by the enclosure address bus. Connecting the EMU CAB ONLY connector to a enclosure address bus JB automatically establishes an En of *01* through *14*. Any drive enclosure not connected to the enclosure address bus has the same En, *00*.

IMPORTANT: The En is automatically assigned. You cannot manually assign an enclosure number.

Based on the cable bus installation shown in Figure 4–19, the enclosures are numbered as shown in Figure 4–18.

CXO7956A
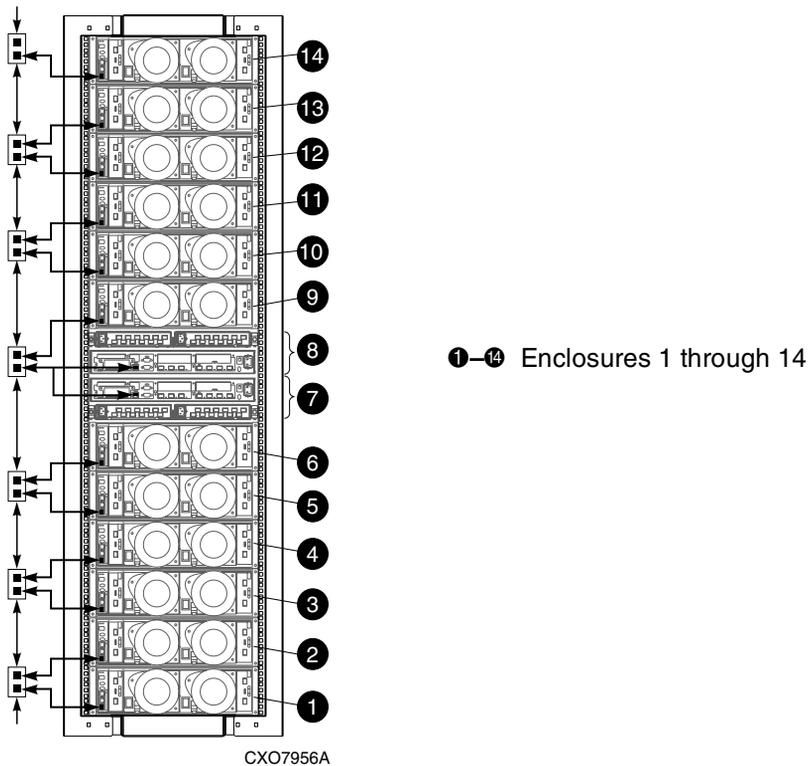
Figure 4–18: Enclosure numbering

❶–⓮ Enclosures 1 through 14

NOTE: If an expansion rack is used with your Enterprise configuration, the enclosure numbering shown above may change or contain additional numbering. Refer to the *StorageWorks by Compaq Enterprise Virtual Array Hardware Configuration Guide* for more information.

For more information about the reporting group number, see "Viewing the Reporting Group Feature" on page 4–34.

Enclosure Address Bus Connections

Connecting the enclosures to the cabinet JBs establishes the enclosure address bus. The enclosures are automatically numbered, based on their physical distance from the bottom terminator. Figure 4–19 shows the typical configuration of a 41U cabinet with 14 enclosures (3U high).

Junction Boxes (JB)

❶ JB 1–Enclosures 1 and 2
❷ JB 2–Enclosures 3 and 4
❸ JB 3–Enclosures 5 and 6
❹ JB 4–Enclosures 7 and 8
❺ JB 5–Enclosures 9 and 10
❻ JB 6–Enclosures 11 and 12
❼ JB 7–Enclosures 13 and 14

Components

❽ Bottom terminator
❾ JB-to-Enclosure cable
  381 mm (15 in), 1 of 14 cables
❿ JB-to-JB cable
  210 mm (8.25 in), 1 of 6 cables
⓫ Top terminator

CXO7957A
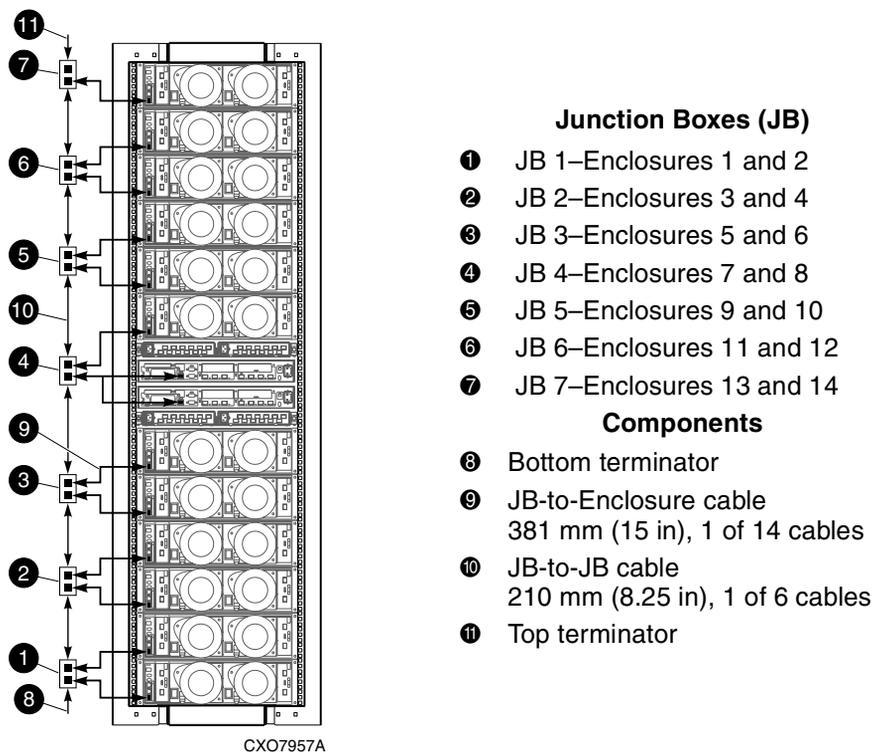
Figure 4–19: Enclosure address bus components

Enclosure and Element Conditions

The EMU constantly monitors enclosure and element operation and notifies you of conditions that could affect operation. These errors are grouped according to their severity, into the following types:

- Unrecoverable condition
- Critical condition
- Noncritical condition
- Information condition

See Appendix B, for definitions of individual condition reports.

When the audible alarm is not muted or disabled, each condition generates a unique audible alarm as described in "Audible Alarm Patterns" on page 4–23.

Using the Condition Reporting Feature

The EMU reports errors to you by changing the alphanumeric display to *Er* and sounding the audible alarm. A condition report has precedence over all other displays.

IMPORTANT: An error always generates a condition report. Not all condition reports are generated by errors.

Condition Report Terminology

Each EMU detected condition generates a condition report containing the following information:

- Element type (et)
- Element number (en)
- Error code (ec)

Each condition report:

- Appears on the EMU alphanumeric display
- Sounds the audible alarm.
- Is stored in the error queue.
- Is provided to the HSV controller for processing and display by the HSV Element Manager.

The condition types, condition reports, and the interaction between conditions are defined in the following sections.

UNRECOVERABLE Condition

This is the most severe condition. The condition occurs when one or more enclosure elements have failed and have disabled some enclosure functions. The enclosure may be incapable of correcting, or bypassing the failure, and requires repairs to correct the error.

IMPORTANT: Compaq recommends implementing corrective action *immediately* for an UNRECOVERABLE condition to maintain data integrity.

This type of condition requires immediate corrective action by you.

An UNRECOVERABLE condition establishes the following conditions:

- This condition has precedence over CRITICAL and NONCRITICAL errors.

- This condition has precedence over the INFORMATION condition.

- The audible alarm is On continuously, as shown in Table 4–11 on page 4–23.

CRITICAL Condition

A CRITICAL condition is less severe than an UNRECOVERABLE condition. This condition occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure of the element makes continued normal operation of at least some elements in the enclosure impossible. Other elements within the enclosure may be able to continue normal operations.

Prompt correction to prevent system degradation is recommended.

A CRITICAL condition establishes the following conditions:

- An UNRECOVERABLE condition has precedence over this condition.

- This condition has precedence over NONCRITICAL errors.

- This condition has precedence over INFORMATION condition.

- When this condition is the most severe condition active, the audible alarm sounds three times per alarm cycle, as shown in Table 4–11 on page 4–23.

NONCRITICAL Condition

A NONCRITICAL condition is less severe than an UNRECOVERABLE condition or a CRITICAL condition. This condition occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure of these elements *do not* affect continued normal operation of the enclosure. All devices in the enclosure continue to operate according to their specifications. The ability of the devices to operate correctly may be reduced should other errors occur.

Early correction to prevent system degradation is recommended.

A NONCRITICAL condition establishes the following conditions:

- An UNRECOVERABLE condition has precedence over this condition.

- A CRITICAL condition has precedence over this condition.

- This condition has precedence over INFORMATION condition.

- When this condition is the most severe error active, the audible alarm sounds two times per alarm cycle, as shown in Table 4–11 on page 4–23.

INFORMATION Condition

This message advises you that a condition exists that does not reduce the capability of an element. However, the condition can become an error and require corrective action. In effect, an INFORMATION condition provides you an early warning, which enables you to prepare to implement corrective action before an element fails.

- Correction of the reported problem may be delayed.

- An INFORMATION condition is the least severe of all the condition reports.

- When only an INFORMATION condition is active, the audible alarm sounds once per alarm cycle as shown in Table 4–11 on page 4–23.

Error Queue

The EMU stores each condition report in the error queue until the problem is corrected, or for at least 15 seconds after the error is reported. This ensures that when there are multiple errors or a recurring error, each can be displayed. The complete report is stored and you recall any report using a combination of the top and bottom pushbuttons. Correcting the error removes the condition report from the error queue.

Each report in the queue contains the element type, the element number, and the error code. To remove information from this queue requires either clearing the error or replacing the EMU.

The EMU displays the error queue information based on:

- The severity of the error

- The time of the error occurred

IMPORTANT: When you are viewing an error, the occurrence of a more severe error takes precedence and the display changes to the most severe error.

The most severe error in the queue always has precedence, regardless of how long less severe errors have been in the queue.

This hierarchical display ensures that the most severe errors have precedence over less severe errors. The earliest reported condition within an error type has precedence over errors reported later. For example, if you have errors at all levels, the EMU displays them as follows:

1. UNRECOVERABLE errors in the sequence they occurred.

2. CRITICAL errors in the sequence they occurred.

3. NONCRITICAL errors in the sequence they occurred.

4. INFORMATION conditions in the sequence they occurred.

Condition Report Format

Each condition report identifies the element affected (type and number), and the primary problem (the error code). Appendix B provides detailed information about each condition report, and includes recommended corrective actions.

- **Element Type**
  This two-digit *hexadecimal* display defines the element type reporting the problem. The format for this display is *e.t.* with a period after each character. *0.1.* through *F.F.* are valid element types.

- **Element Number**
  The second display is a two-digit *decimal number* that defines the element reporting the problem. The format for this display is *en.* with a period after the second character.

- **Error Code**
  The third display is a two-digit *decimal number* that defines the specific error code. The format for this display is *ec* without any periods.

Navigating the Error Display

An active error changes the alphanumeric display to *Er* and activates the error menu. The pushbutton functions are now dedicated to error display.

For example, should the following conditions exist:

- There is a high temperature CRITICAL condition for the disk drive in bay 9.

- There is a EMU NVRAM write failure NONCRITICAL condition.

As soon as one of these conditions is reported the alphanumeric display is Er, the top pushbutton LED is On, and the audible alarm is beeping three times per cycle.

Complete the following procedure to analyze the disk drive condition report.

1. To move from the error display to the error code, press and hold the top pushbutton until the error code is displayed.

NOTE: The display will first move to the element type display, then to the element number, then to the error code.

2. Release the top pushbutton when the error code is displayed.

3. To move to the element type, press and release the top pushbutton.

NOTE: Pressing and releasing the bottom pushbutton allows you to move from the element type display, the element number display, or the error code display directly to the *Er* display.

Condition Report Analysis

As described in Appendix B, condition report analysis involves:

1. Identifying the element.

2. Determining the major problem.

3. Defining additional problem information.

Using the Loop ID Feature

This section describes how the Fibre Channel Arbitrated Loop Physical Addresses (AL_PAs) are assigned and defines the available hexadecimal addresses. This information *is not required* to operate a FC-AL drive enclosure. This section does not provide the processes involved in assigning addresses to storage devices.

IMPORTANT: The EMU has the capability of requesting a new loop ID for the first bay in an enclosure. Implementing this option in an Enterprise Storage System may cause problems. Therefore, procedures for recommending different loop IDs are not documented.

Viewing the Reporting Group Feature

Another function of the enclosure address bus is to provide communications within a reporting group. A Reporting Group (rG) is an HSV controller pair and the associated drive enclosures. The controller pair *automatically assigns* a unique (decimal) four-digit Reporting Group Number (RGN) to each EMU on an FC-AL.

Each of the drive enclosures on a loop pair are in one reporting group:

- All of the drive enclosures on loop pair 1, both loop 1A and loop 1B, share a unique reporting group number.

- All of the drive enclosures on loop pair 2, both loop 2A and loop 2B, share a unique reporting group number.

Each EMU collects environmental information from the associated enclosure and broadcasts the information to reporting group members using the enclosure address bus. Information from enclosures in other reporting groups is ignored.

The reporting group feature provides a means of segregating, identifying, categorizing, isolating, and separating controller enclosure and drive enclosure environmental information. The feature does not use the FC-AL bus—the "in-band" communications. Instead this feature uses "out-of-band" communications.

IMPORTANT: The EMU has the capability of requesting a different RGN for an enclosure. Do not implement this option in an Enterprise Storage System because it may cause problems. Procedures for requesting a different RGN are not documented.

Reporting Group Numbers

The reporting group number (RGN) range is *0000* through *4099*, decimal.

- *0000* is reserved for enclosures that are not part of any reporting group, a JBOD configuration.

- *0001* through *0015* are RGNs reserved for use by the EMU. When you enter them, they default to *0000*.

- *0016* through *4095* are valid RGNs.

- *4096* through *4099* are invalid RGNs. When you enter them, they default to *4095*.

The reporting group numbers are displayed on the EMU alphanumeric display as a pair of two-digit displays. These two displays are identified as *rH* and *rL*.

- Valid *rH* displays are in the range *00* through *40*, and represent the high-order (most significant) two-digits of the RGN.

- Valid *rL* displays are in the range *00* through *99*, and represent the low-order (least significant) two-digits of the RGN.

How to View a Reporting Group Number

Complete the following procedure to view a reporting group number, such as *2553*.

1. Press and release the bottom pushbutton until the alphanumeric display is *rG*.

2. To display two most significant Reporting Group numbers press and hold the top pushbutton unit the display is *rH*.

3. Press and release the top pushbutton to display the first two-digits of the RGN.

4. Press and release the top pushbutton until the alphanumeric display is *rH*.

5. Press and hold the top pushbutton until the alphanumeric display is *rL*.

6. Press and release the top pushbutton to display the last two digits of the RGN.

7. To exit the display, press and release the bottom pushbutton until the alphanumeric display is *rG*.

Verifying Enclosure Operation

All the elements in the enclosure begin operating when power is applied. Check the enclosure status LEDs in the front, lower right corner (see Figure 4–20). If the display is not exactly as shown, an error condition exists. To determine the defective element, check the drive status LEDs on the front, the EMU, the power supplies, and the blowers, as well as checking the I/O module status LEDs on the rear (see Table 4–12).

Either of the drive displays in Figure 4–20 indicates a properly functioning disk.

CXO7958A
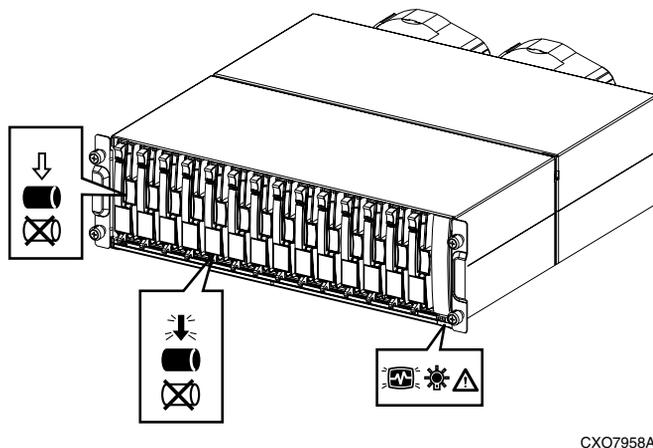
Figure 4–20: Typical operational LED status displays—enclosure front

Figure 4–21 shows the location of the status displays. See Table 4–12 for state descriptions of the status LEDs.

CXO7959A
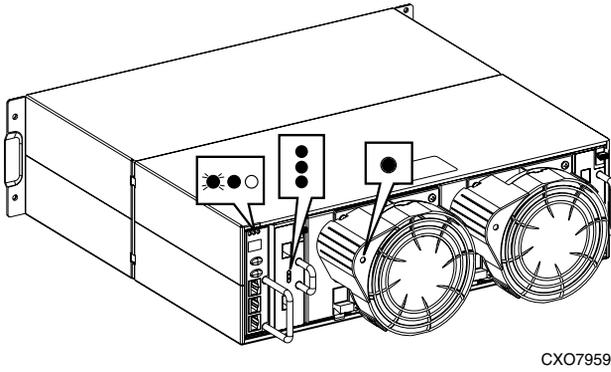
Figure 4–21: Location of LED status displays—enclosure rear

Table 4–12: LED status displays

EMU LEDs and Icons

	The enclosure power (both the +5 VDC and +12 VDC) is present and correct. There are NO enclosure faults.

I/O Module A and I/O Module B LEDs

For information about I/O Module LED status displays, see "I/O Module Status Displays" on page 4–5.

Power Supply and Blower LEDs

	Both the power supply and the blower are operational.

Status Monitoring and Display

The major status monitoring capabilities of these enclosures include:

- Displaying the enclosure status on the enclosure icons

- Displaying the blower, power supply, EMU, drive, and I/O module status on the element LEDs

- Detecting the installation of blowers, power supplies, drives, or I/O modules

- Detecting the removal of blowers, power supplies, drives, or I/O modules

- Sensing enclosure internal temperatures

- Sensing power supply voltage, current, and total power

- Sensing ambient temperature

NOTE: The ambient temperature is the temperature at the enclosure air intake, or the room temperature.

Enclosure Status Icons

The enclosure status LEDs are located on the enclosure backplane. These LEDs illuminate the status icons (see Table 4–13) in the front, lower-right corner of the enclosures (see ⓯, Figure 4–20 on page 4–35).

Table 4–13: Enclosure Status Icon Displays

Icon	Off	On	Flashing
EMU "Heartbeat" Icon (green LED)			
Power Icon (green LED)			
Enclosure Status Icon (orange LED			

Fibre Channel Loop Switches

The Enterprise Virtual Array uses four FC Loop Switches (Figure 4–22) to connect all of the drive enclosures to the controller pair via FC cables. Each switch acts as a central point of interconnection and establishes a fault-tolerant physical loop topology.
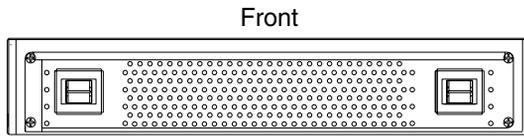
Front

Figure 4–22: FC Loop switch—front and rear views

Power-On Self Test

When you power On the Fibre Channel Switch, the switch performs a Power-On Self Test (POST). A POST verifies that the switch is functioning properly. During a POST, all of the LEDs turn On for approximately two seconds. Then, all of the LEDs, except the Power LED, turn Off.

If the Port Bypass LEDs are blinking at a constant rate and the POST Fault LED is On, the switch detected a fault during the POST. When a POST detects a fault, contact your Compaq Authorized Service Provider.

Reading the Switch LEDs

The Fibre Channel Switch contains both System LEDs and Port LEDs. The System LEDs indicate the status of the switch, and the Port LEDs provide status about a specific port. Figure 4–23 shows the Fibre Channel Switch with the System and Port LEDs.

Rear

❶ SFP Status LED
❷ Port Bypassed LED
❸ POST Fault LED
❹ Over Temp LED
❺ Power LED
❻ Loop Operational LED
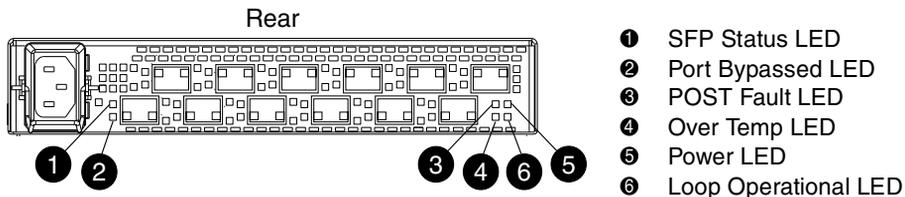
Figure 4–23: Fibre Channel Switch LEDs

Table 4–14 describes the System LEDs.

Table 4–14: Fibre Channel Switch System LEDs

System LED	Description
Power	A green LED. When lit, this LED indicates that the switch is plugged in and the internal power is functional.
Loop Operational	A green LED. When lit, this LED indicates that the Fibre Channel loop has completed initialization and is now operational.
POST Fault	An amber LED. When lit, this LED indicates that the internal hardware self-test failed and the switch will not function.
Over Temp	An amber LED. When lit, this LED indicates that the ambient temperature has exceeded 45 °C. The switch is still functional; however you should correct the problem immediately. The Over Temp LED turns Off when the problem is corrected.

Table 4–15 describes the Port LEDs.

Table 4–15: Fibre Channel Switch Port LEDs

SFP Status LED Green	Port Bypassed LED Amber	Description
Off	Off	Indicates that the port does not have an SFP installed and is bypassed by the loop.
On	Off	Indicates that the port is operating normally. The port and device are fully operational.
On	On	Indicates the that port is in a bypassed state. The port is non-operational due to loss of signal, poor signal integrity, or the Loop Initialization Procedure (LIP). **NOTE:** This condition is also normal when the SFP is present but not attached to an FC-AL node or when the SFP is present and attached to only a cable assembly. Attaching the SFP to a device and plugging it into the port should initiate the LIP by the attached device.
Off	On	Indicates a Tx fault. The port is non-operational due to an SFP transmitter fault, improperly-seated SFP, or another failed device.

Problem Isolation

Table 4–16 lists several basic problems and their solutions.

Table 4–16: Fibre Channel Switch Basic Troubleshooting

Problem	Recommended Action
SFPs are installed in ports but no LEDs are lit.	1. Verify that the power cord is firmly seated in the switch and is connected to the power outlet. 2. Check the Power LED to verify that the switch is On.
SFP is installed, but the Port Bypassed LED is lit.	Re-seat the SFP. If the same condition occurs, the SFP is probably faulty and should be replaced.
SFP is installed, but the SFP Status LED and the Port Bypassed LED are lit.	This condition indicates that the switch is not receiving a valid Fibre Channel signal or that the switch is receiving an LIP. 1. Ensure that the switch is powered On. 2. Contact your Compaq Authorized Service Provider for further assistance.

SFP is installed and the SFP Status LED is lit, but the devices are not communicating.	This condition indicates that the switch is receiving a valid Fibre Channel signal, but there are no upper level protocols active.
	
	1. Verify that you are running the correct firmware on all storage system hardware.
	
	2. Check the Loop Operational LED.
	
	    a. If the Loop Operational LED is lit, the devices have completed initialization.
	
	    b. If the Loop Operational LED is Off, the devices were not initialized. Disconnect the devices from the switch. Reconnect the devices one at a time. This will allow you to isolate the device that is responsible for the loop failure.
	
	3. Contact your Compaq Authorized Service Provider for further assistance.

HSV Controllers

This section describes the major features, purpose, and function of the HSV controllers (see Figure 4–24). Each Enterprise Storage System has a pair of these controllers.
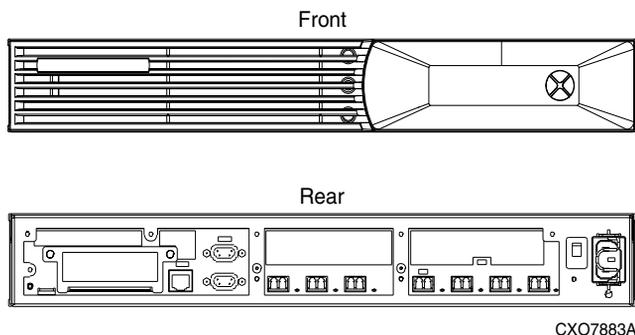
Figure 4–24: HSV-series controller

High Availability Features

Mounting two interconnected HSV Controllers ensures that the failure of a controller element (such as a power supply, transceiver, fiber optic cable, Fibre Channel port, and so forth) does not disable the system. The complete data redundancy includes two Loop A and two Loop B data paths.

A single controller can fully support an entire system until the defective controller, or controller element, is repaired.

If a blower fails, it can be replaced without shutting down the system.

Each HSV Controller has two lead-acid cache battery assemblies that provide power to the cache memory dual in-line memory modules (DIMMs). Each battery assembly has three lead-acid, nonspillable cells. *When both battery assemblies are fully charged*, they can provide power to the DIMMs for up to 96 hours.

Operator Control Panel

The OCP (see Figure 4–25) is an interface between you and the controller. Much of the information provided here duplicates information displayed on the HSV Element Manager graphical user interface (GUI). Even if you cannot observe the GUI, or if the GUI is not functioning, the controller status is available on the OCP. You can use the OCP LEDs, the LCD, and the pushbuttons to determine the controller status.

The OCP displays system information (status and error conditions) and lets you enter data or isolate problems.
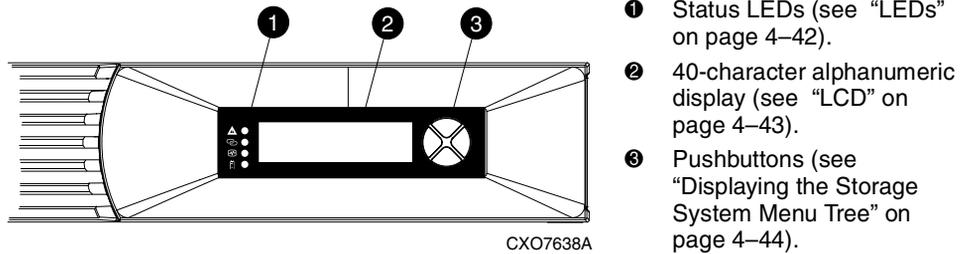
❶ Status LEDs (see "LEDs" on page 4–42).

❷ 40-character alphanumeric display (see "LCD" on page 4–43).

❸ Pushbuttons (see "Displaying the Storage System Menu Tree" on page 4–44).

CXO7638A

Figure 4–25: Controller OCP

LEDs

The status LEDs indicate the internal status of the controller, as described in Table 4–17. During initial setup, the status LEDs may not be fully operational.

The following sections define the alphanumeric displays modes, including the possible displays, the valid LED displays, and the pushbutton functions.

Table 4–17: Controller Status Icons and LEDs

⚠	**Fault LED** When the amber LED to the right of this icon is On or Flashing, there is a controller problem. Check either the HSV Element Manager GUI or the LCD Fault Management displays for a definition of the problem and recommended corrective action.
🔗	**Host Link LED** When the green LED next to this icon is On, there is a link between the storage system and a host. When the red LED next to this icon is Off, there is no link between the storage system and a host.
💓	**Controller "Heartbeat" LED** When the green LED next to this icon is Flashing slowly, a heartbeat, the controller is operating normally. When this LED is not Flashing, there is a problem.
🔋	**Cache Battery Assembly LED** When the red LED next to this icon is Off, the battery assembly is charged. When this LED is On, the battery assembly is discharged.

Navigation Pushbuttons

The information displayed by the OCP, the data you can enter, and the navigation pushbutton functions depend on the alphanumeric display mode.

To simplify presentation and to avoid confusion, the pushbutton reference names, regardless of labels, are *left*, *right*, *top*, and *bottom* (see Figure 4–26).

Top Pushbutton

Left Pushbutton   Right Pushbutton

Bottom Pushbutton
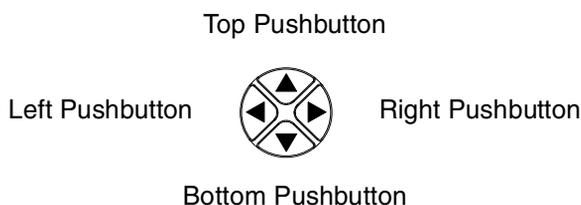
Figure 4–26: Navigation pushbutton icons

LCD

The two LCD rows display up to 20 alphanumeric characters per row. The LCD alternates between displaying the Storage System Name and the Node WorldWide Name (see Figure 4–27).

IMPORTANT: An active (Flashing) display, an error condition message, or a user entry (pressing a pushbutton) overrides the default display. When none of these conditions exist, the default display is active after approximately 15 seconds.

```
Storage System Name:

SCELL22MAY200111543

Node WorldWide Name:

5000-1FE1-0000-0000
```
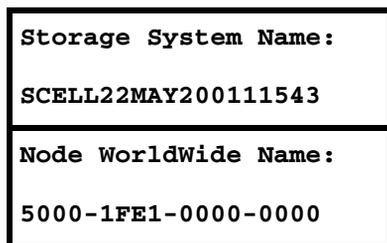
Figure 4–27: Default LCD display

Displaying the Storage System Menu Tree

The Storage System Menu Tree lets you select information to be displayed (for example, System Information, Fault Management) or select procedures to implement (Shutdown System, System Password). To display this tree, press ▲, ▼, ◀, or ▶ when either of the default displays is active.

- When you select either System Information or Fault Management, you can display, but not change, product information.

- Selecting Shutdown System lets you implement the procedure for shutting down the system in a logical, sequential manner. Using the Shutdown System procedure maintains data integrity and avoids the possibility of losing or corrupting data.

- Selecting System Password lets you create a system password to ensure that only authorized personnel can modify system operation and functions from the HSV Element Manager.

Use the following procedure to select and navigate the storage system menu tree.

1. The default display alternates between the Storage System Name display and the Node WorldWide Name display.

```
Storage System Name:

SCELL22MAY200111543
```

Push any pushbutton (◀ ▶ ▼ ▲) to select the Storage System Menu Tree display.

```
Node WorldWide Name:

5000-1FE1-0000-0000
```

2. System Information is the active display.

   Press ▼ to sequence down through the tree.

   Press ▲ to sequence up through the tree.

   Press ▶ to select an active display.

   Press ◀ to select the default display.

```
System Information

Fault Management
```

```
System Information

Fault Management
```

```
Shutdown System

System Password
```

Displaying System Information

IMPORTANT: The purpose of this information is to assist the Compaq Authorized Service Provider when servicing your system.

The system information displays show the system configuration including the VCS version, the OCP firmware and application programming interface (API) versions, and the enclosure address bus programmable integrated circuit (PIC) configuration. You can only view, *not change*, this information.

When there is no activity for approximately 15 seconds, the display automatically returns to the default display.

NOTE: Activity is either an active error report or pressing a pushbutton.

Table 4–18 defines the pushbutton functions.

Table 4–18: System Password Pushbutton Functions

▼	Use this pushbutton to: • Move from the Versions VCS display to the Versions OCP display • Move from the Versions OCP display to the Versions Address Bus PIC display
▲	Use this pushbutton to: • Move from the Versions OCP display to the Versions VCS display • Move from the Versions PIC display to the Versions OCP display
▶	Use this pushbutton to: • Move from the System Information display to the Versions VCS display • Move from the Versions VCS display to the VCS detail display • Move from the Versions OCP display to the OCP detail display • Move from the Versions PIC display to the detailed PIC display
◀	Use this pushbutton to: • Move from the System Information display to the default display • Move from the Versions display to the System Information display • Move from VCS detail display to the Versions VCS display • Move from the OCP detail display to the Versions OCP display • Move from the PIC detail display to the Versions PIC display

Displaying Versions System Information

When you press ▼, the active display is Versions. From the Versions display you can determine the:

- VCS revision level

- OCP firmware revision level

- PIC (programmable integrated circuit) firmware revision level for:

  — Address Bus PIC

  — Battery PIC

  — PowerPC Processor

  — Quasar

  — glue FPGA (field programmable gate array) PIC

  — Surge

NOTE: The PIC terms PowerPC Processor, Quasar, glue FPGA, and Surge are for development purposes and have no significance for normal operation.

If the requested version information is not available, the display is always <NOT AVAILABLE>. Use the following procedure to select and display System Information.

NOTE: When viewing the software or firmware version information, pressing ◀ displays the Versions Menu tree.

1. The default display alternates between the Storage System Name display and the Node WorldWide Name display.

    ```
    Storage System Name:

    SCELL22MAY200111543
    ```

    Press any pushbutton to select the Storage System Menu Tree display.

    ```
    Node WorldWide Name:

    5000-1FE1-0000-0000
    ```

2. Press ▶ to go to step 3, VCS.

    Press ▼ to select Fault Management.

    ```
    System Information

    Fault Management
    ```

3. Press ▶ to display the VCS version.

   Press ▼ to go to step 4, OCP.

   ```
   Versions Menu

   VCS
   ```

4. Press ▶ to display the OCP versions menu.

   Press ▼ to go to step 5, Address Bus PIC.

   ```
   Versions Menu

   OCP
   ```

5. Press ▶ to display the Address Bus PIC.

   Press ▼ to go to step 6, Battery PIC.

   ```
   Versions Menu

   Address BUS PIC
   ```

6. Press ▶ to display the Battery PIC.

   Press ▼ to go to step 7, PowerPC Processor.

   ```
   Versions Menu

   Battery PIC
   ```

7. Press ▶ to PowerPC Processor.

   Press ▼ to go to step 8, Quasar.

   ```
   Versions Menu

   PowerPC Processor
   ```

8. Press ▶ to display the Quasar version.

   Press ▼ to go to step 9, glue FPGA version.

   ```
   Versions Menu

   Quasar
   ```

9. Press ▶ to display the glue FPGA version.

   Press ▼ to go to step 10, surge PIC.

   ```
   Versions Menu

   glue FPGA
   ```

10. Press ▶ to display the surge version.

    ```
    Versions Menu

    surge
    ```

Shutting Down the System

⚠ **CAUTION:** To power Off the system for more than 96 hours, use the HSV Element Manager.

You can use the shutdown system function to implement the following methods:

- Restarting the system (see "Restarting the System" on page 4–50).

- Turning Off the power (see"Powering Off the System" on page 4–51).

- Initializing the system (see "Initializing the System" on page 4–51).

To ensure that you do not mistakenly activate a shutdown procedure, the default state is always NO, indicating *do not implement this procedure*. Implementing any shutdown method requires you to complete at least two actions.

Table 4–19: Shutdown Methods

LCD Prompt	Description
RESTART	Implementing this procedure establishes communications between the storage system and the HSV Element Manager.
	This procedure is used to restore the controller to an operational state where it can communicate with the HSV Element Manager.
POWER OFF	Implementing this procedure initiates the sequential removal of controller power. This ensures no data is lost.
	The reasons for implementing this procedure include replacing a disk drive enclosure.
INITIALIZE	Implementing this procedure will cause the loss of all data. For a detailed discussion of this procedure, see "Initializing the System" on page 4–51.

Use the following procedure to select the Shutdown System display and execute a shutdown procedure.

1. The default display alternates between the Storage System Name display and Node WorldWide Name display.

```
Storage System Name:

SCELL22MAY200111543
```

Push any pushbutton to go to step 2, System Information.

```
Node WorldWide Name:

5000-1FE1-0000-0000
```

2. Press ▼ to go to step 3, Fault Management.

```
System Information

Fault Management
```

3. Press ▼ to go to step 4, Shutdown System.

   Press ▲ to select System Information.

```
System Information

Fault Management
```

4. Press ▶ to go to step 5, Restart.

   Press ▲ to go to step 3, Fault Management.

```
Shutdown System

System Password
```

5. Press ▶ to display the Restart menu.

   Press ▼ to go to step 6, Power Off.

```
Restart

Power Off
```

6. Press ▶ to display the Restart.

   Press ▼ to go to step 7, Initialize System.

```
Restart

Power Off
```

7. Press ▶ to display the Initialize System menu.

   Press ▲ to go to step 6, Power Off.

```
Power Off

Initialize System
```

Once you have selected the Shutdown System function, you can select and execute a shutdown method as described in the following sections.

Restarting the System

To restore the controller to an operational state, use the following procedure to restart the system.

1. Press ▶ to go to step 2, Restart.

    ```
    Shutdown System

    System Password
    ```

2. Press ▶ to display step 3, RESTART SYSTEM NO.

    Press ▼ to go to Power Off.

    ```
    Restart

    Power Off
    ```

3. Press ◀ to accept NO and go to step 1.

    Press ▼ to go to step 4; RESTART SYSTEM YES

    ```
    RESTART SYSTEM

                            NO
    ```

4. Press ◀ to accept YES and to go to step 5, HSV110 Startup.

    ```
    RESTART SYSTEM

                           YES
    ```

5. No user input is required. The system will automatically initiate the startup procedure and proceed to step 6.

    ```
    HSV110 Startup

    *******************
    ```

6. The system automatically loads the Storage System name and Node WorldWide Name information from the operational controller.

    ```
    Storage System Name:

    SCELL22MAY200111543
    ```

    ```
    Node WorldWide Name:

    5000-1FE1-0000-0000
    ```

Powering Off the System

Use the following procedure to remove power from the controller pair, save the data, and remove the storage system from the HSV Element Manager.

IMPORTANT: Implementing this procedure removes power from the controller pair and all associated drive shelves. To restore power to the controller system, you must cycle both PDU breakers in the enclosure.

1. Press ▶ to go to step 2, Restart.

```
Shutdown System

System Password
```

.

2. Press ▼ to go to step 3, Power Off.

```
Restart

Power Off
```

3. Press ▶ to go to step 4, POWER OFF SYSTEM.

   Press ▼ to select Initialize System.

```
Restart

Power Off
```

4. Press ◀ to accept NO and go to Step 3.

   Press ▼ to go to step 5, POWER OFF SYSTEM YES

```
POWER OFF SYSTEM

                      NO
```

5. Press ◀ to accept YES.

   Press ▲ to select NO and return to step 4.

```
POWER OFF SYSTEM

                     YES
```

Initializing the System

Initializing the system is another way to shut down the system. This action will cause the loss of all storage system data. Since the HSV Element Manager cannot communicate with the disk drive enclosures, the stored data cannot be accessed. This destroys the storage system and all the data.

⚠ **CAUTION:** Initializing the system destroys all user data. Any data stored on the system will be permanently destroyed. The WWN will remain in the controller unless both controllers are powered Off. The password will be lost. If the controllers remain powered On until you create another storage system (initialize via GUI), you will not have to re-enter the WWN.

Use the following procedure to initialize the system.

1. Press ▶ to go to step 2, Restart.

Shutdown System
System Password

.

2. Press ▼ to select Power Off.

Restart
Power Off

3. Press ▼ to select Initialize System and go to step 4.

Power Off
Initialize System

4. Press ▶ to select INITIALIZE SYSTEM NO and go to step 5.

INITIALIZE SYSTEM
NO

5. Press ◀ to accept NO and go to step 4.

   Press ▼ to go to Step 6, INITIALIZE SYSTEM YES.

INITIALIZE SYSTEM
NO

6. Press ◀ to accept YES and to go to Step 7, REALLY INIT SYSTEM NO.

INITIALIZE SYSTEM
YES

7. Press ◀ to accept NO and go to step 6.

    Press ▼ to go to step 8, REALLY INIT SYSTEM YES.

```
┌─────────────────────────────┐
│ REALLY INIT SYSTEM?         │
│                             │
│                        NO   │
└─────────────────────────────┘
```

8. Press ◀ to accept YES and go to step 9.

    Press ▲ to go to step 7, REALLY INIT SYSTEM NO.

```
┌─────────────────────────────┐
│ REALLY INIT SYSTEM?         │
│                             │
│                       YES   │
└─────────────────────────────┘
```

9. Press ◀ to accept NO and go to step 8.

    Press ▼ to go to step 10, PROCEED YES.

```
┌─────────────────────────────┐
│ DATA WILL BE LOST           │
│                             │
│ PROCEED?              NO    │
└─────────────────────────────┘
```

10. Press ◀ to accept YES and go to step 11.

    Press ▲ to go to step 9, PROCEED no.

```
┌─────────────────────────────┐
│ DATA WILL BE LOST           │
│                             │
│ PROCEED?             YES    │
└─────────────────────────────┘
```

The system is initialized.

```
┌─────────────────────────────┐
│ SYSTEM INIT                 │
│                             │
│ IN PROCESS                  │
└─────────────────────────────┘
```

Password Options

The password entry options are:

- Entering a password during storage system initialization (see "Setting Up an HSV-Series Controller Pair Using the OCP" on page 4–56).

- Showing the current password. The actual password is not displayed, instead an indicator informs you of whether a password has been set.

- Changing a password (see "Changing a Password").

- Removing password protection (see "Clearing a Password").

Changing a Password

For security reasons, you may need to change a storage system password. First you must select a new, unique, eight-character password, using the uppercase letters A through Z and the lowercase letters a through z.

After selecting the new password, use the following procedure to change the password.

IMPORTANT: Changing a system password on the controller requires changing the password on any HSV Element Manager with access to this system.

1. Press ▶ to go to step 2, Change Password. Press ▲ to go to Shutdown System.

```
Shutdown System

System Password
```

.
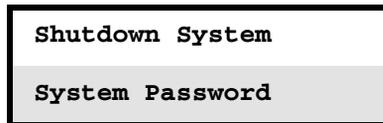
2. Press ▶ to go to step 3, CHANGE PASSWORD NO. Press ▼ to go to Clear Password.

```
Change Password

Clear Password
```

3. Press ◀ to accept NO and go to step 2. Press ▼ to go to step 4, CHANGE PASSWORD YES.

```
CHANGE PASSWORD?

                        NO
```

4. Press ◀ to accept YES and go to step 5. Press ▲ to go to step 3, CHANGE PASSWORD NO.

```
CHANGE PASSWORD?

                       YES
```

5. To enter the first character, press either ▲ or ▼ to select an uppercase or lowercase character.

   Press ▶ to accept a character and select the next password character. The character display changes to an asterisk.

```
Enter Password

*AAAAAAA
```

6. Repeat step 5 for the remaining seven characters.

   Press ◀ to accept the password and go to step 7, CHANGE PASSWORD YES.

```
Enter Password

********
```

7. Press ◀ to go step 8, System Password.

```
CHANGE PASSWORD?

                       YES
```

8. The system will automatically return to the default display.

```
Shutdown System

System Password
```
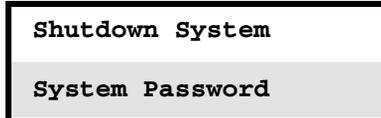
Clearing a Password

Use the following procedure to remove storage system password protection.

IMPORTANT: Changing a system password on the controller requires changing the password on any element manager with access to this system.

1. Press ▶ to go to step 2, Change Password.

   Press ▲ to go to Shutdown System.

```
Shutdown System

System Password
```

2. Press ▼ to go to Clear Password.
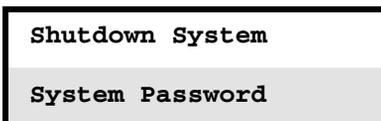
```
Change Password

Clear Password
```

3. Press ▼ to select Clear Password.

```
Change Password

Clear Password
```

4. Press ◀ to keep the password and go to step 3. Press ▼ to go to step 5, CLEAR PASSWORD YES.

```
CLEAR PASSWORD?

                    NO
```

5. Press ◀ to clear the password and go to step 6. Press ▲ to keep the current password and go to step 3, CLEAR PASSWORD NO.

```
CLEAR PASSWORD?

                   YES
```

6. The system will automatically return to the default display.

```
Change Password

Clear Password
```

Setting Up an HSV-Series Controller Pair Using the OCP

For information about how to set up an HSV-series controller pair during initial installation see "Setting Up an HSV-Series Controller Pair Using the OCP," on page 2–9.

HSV Controller Cabling

On the rear of the controller are the data and power connections. The data connections are the interface to the disk drive enclosures, the other controller, and the fabric (host) or the HSV Element Manager.

All data cables and power cables attach to the rear of the HSV controller (see Figure 4–28). Adjacent to each data connector (see ❹, ❺, ❻, ❼, ❽, ❾, and ❿) is a two-colored LED that defines the link status.

- When the green LED is On, the link can communicate.

- When the amber LED is On, the link cannot communicate.

IMPORTANT: These LEDs do not indicate whether there is communication on the link, only whether the link can transmit and receive data.

NOTE: In Figure 4–28, the connectors are identified by the label printed on the controller. The information in the parentheses defines the connector function.

CXO7562A
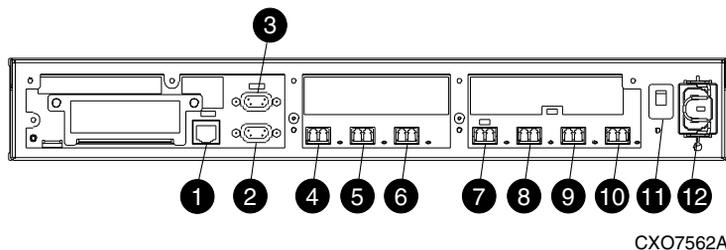
❶	CAB (address bus)	❼	1B (loop 1B)
❷	UART (not used)	❽	2B (loop 2B)
❸	UART (not used)	❾	1A (loop 1A)
❹	FP 1 (fabric port 1)	❿	2A (loop 2A)
❺	FP 2 (fabric port 2)	⓫	AC power switch
❻	MP (multiport)	⓬	AC power connector

Figure 4–28: HSV controller connectors—rear view

Enterprise Racks

Each rack has four feet and four casters. Raising the adjustable feet places the rack weight on the casters, so you can easily move the rack. Lowering the feet places the rack weight on the feet and prevents the rack from moving. The removable front and rear doors, and the removable side panels provide easy access to the rack interior.

Each configuration has an upper and lower controller enclosure (the controller pair), drive enclosures, and an expansion bulkhead. Each controller pair and all the associated drive enclosures form a single storage system.

Rack Configurations

Each system configuration depends on the following factors:

- The controller pair (Model HSV110)
- The number of 3U Fibre Channel drive enclosures per rack

For more information about Enterprise racks and configuration information, including expansion and interconnection, refer to the *StorageWorks by Compaq Enterprise Virtual Array Hardware Configuration Guide*.

Power Distribution

AC power is distributed to the rack through a dual Power Distribution Unit (PDU) assembly mounted at the bottom rear of the rack. The characteristics of the full redundant rack power configuration are as follows:

- Each PDU is connected to a separate circuit-breaker-protected, 30-A AC site power source (220–240 VAC ±10%, 50 or 60 Hz, ±5%). Figure 4–29 illustrates the compatible 60-Hz and 50-Hz wall receptacles.

CXO7549A

CXO5409B

NEMA L6-30R receptacle, 3-wire, 30-A, 60-Hz   IEC 309 receptacle, 3-wire, 30-A, 50-Hz

Figure 4–29: 60-Hz and 50-Hz wall receptacles

IMPORTANT: If local regulations forbid use of these receptacles, you must change the connectors on the PDU power cords.

- The standard power configuration for any Enterprise Storage System rack is the fully redundant configuration. Implementing this configuration requires:

  — Two separate circuit-breaker-protected, 30-A site power sources with a compatible wall receptacle (see Figure 4–29).

  — One dual PDU assembly. Each PDU connects to a different wall receptacle.

  — Eight Power Distribution Modules (PDM) per rack. Four PDMs mount vertically on each side of the rack. Each set of four PDMs connects to a different PDU.

  — The drive enclosure power supplies on the left (PS 1) connect to the PDMs on the left with a gray, 66 cm (26 in) power cord.

  — The drive enclosure power supplies on the right (PS 2) connect to the PDMs on the right with a black, 66 cm (26 in) power cord.

  — The upper controller connects to a PDM on the left with a gray, 60 in (152 cm cm) power cord.

  — The lower controller connects to a PDM on the right with a black, 26 in (66 cm) power cord.

The configuration provides complete power redundancy and eliminates all single points of failure for both the AC and DC power distribution.

PDUs

Each Enterprise Storage System rack has either a 50- or 60-Hz, dual PDU mounted at the bottom rear of the rack.

IMPORTANT: The major difference between the two PDU types is the cable power connector.

- The standard 50-Hz PDU cable has an IEC 309, 3-wire, 30-A, 50-Hz connector.
- The standard 60-Hz PDU cable has a NEMA L6-30P, 3-wire, 30-A, 60-Hz connector.

If these connectors are not compatible with the site power distribution, you must replace the PDU power cord cable connector.

Each of the two PDU power cables has an AC power source specific connector. The circuit-breaker-controlled PDU outputs are routed to a group of four AC receptacles (see Figure 4–30). The voltages are then routed to PDMs, sometimes referred to as AC power strips, mounted on the two vertical rails in the rear of the rack

CXO7570A
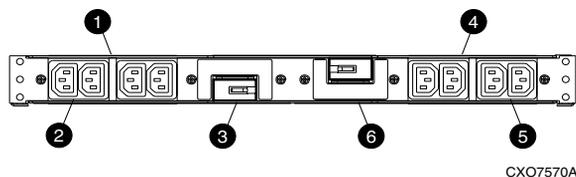
❶	PDU 1	❹	PDU 2
❷	PDU 1 AC receptacles	❺	PDU 2 AC receptacles
❸	PDU 1 circuit breaker	❻	PDU 2 circuit breaker

Figure 4–30: Dual PDU assembly—top view

PDU 1

PDU 1 connects to AC power distribution source 1. A PDU 1 failure:

- Disables the power distribution circuit

- Removes power from PDMs 1, 2, 3, and 4

- Disables PS 1 in the drive enclosures

- Disables the upper controller power supply

PDU 2

PDU 2 connects to AC power distribution source 2. A PDU 2 failure:

- Disables the power distribution circuit

- Removes power from PDMs 5, 6, 7, and 8

- Disables PS 2 in the drive enclosures

- Disables the lower controller power supply

PDU Assembly

The dual PDU assembly (see Figure 4–31) mounts in the lower rear of the rack. This assembly contains two PDUs: PDU 1 ❶ and PDU 2 ❼. Each PDU has a 250-VAC, 30-A circuit breaker(❻ and ⓬) and four IEC 320-C13 AC output power receptacles (❷ through ❺, and ❽ through ⓫). The circuit breakers and AC receptacles are accessible when the PDU assembly is in the upright position.
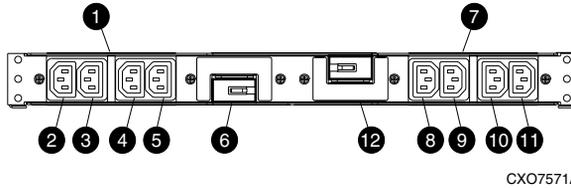
CXO7571A

❶	PDU 1	❼	PDU 2
❷	PDU 1 receptacle A	❽	PDU 2 receptacle A
❸	PDU 1 receptacle B	❾	PDU 2 receptacle B
❹	PDU 1 receptacle C	❿	PDU 2 receptacle C
❺	PDU 1 receptacle D	⓫	PDU 2 receptacle D
❻	PDU 1 circuit breaker	⓬	PDU 2 circuit breaker

Figure 4–31: Dual PDU assembly major components

During normal operation, the hinged PDU assembly is in the upright position and the rear door is closed.

PDMs

There are eight PDMs mounted in the rear of each rack:

• Four mounted on the left vertical rail connect to PDU 1.

• Four mounted on the right vertical rail connected to PDU 2.

Each PDM has six AC receptacles and two thermal circuit breakers. The PDMs distribute the AC power from the PDUs to the enclosures. Two power sources exist for each controller pair and drive enclosure. If a PDU fails, the system will remain operational.

⚠ **CAUTION:** The AC power distribution within a rack ensures a balanced load to each PDU and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition. Compaq supports only the AC power distributions defined in this user guide.

❶ Power receptacles
❷ Thermal circuit breakers
❸ IEC309 AC power connector

CXO7568B
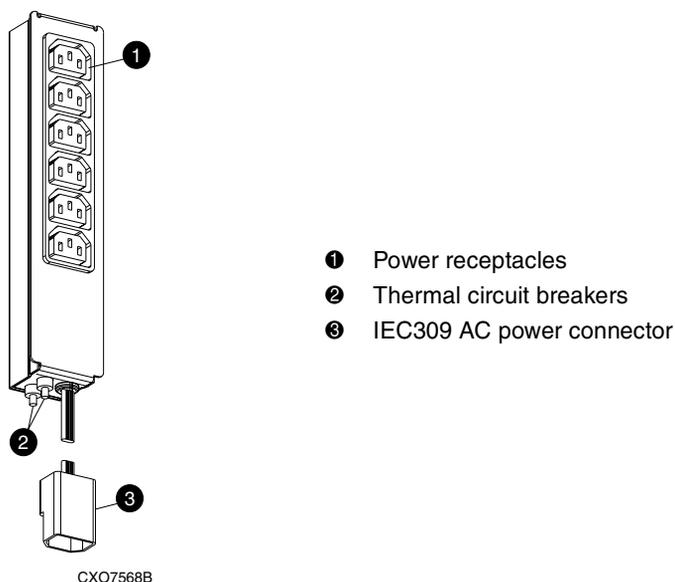
Figure 4–32: Rack PDM

Rack AC Power Distribution

The power distribution in an Enterprise Storage System rack is the same for all variants. The site AC input voltage is routed to the dual PDU assembly mounted in the rack lower rear. Each PDU distributes AC to a maximum of four PDMs mounted on the left and right vertical rails (see Figure 4–33).

- PDMs 1 through 4 connect to receptacles A through D on PDU 1. *Grey* power cords connect these PDMs to the number 1 drive enclosure power supplies and to the *upper controller enclosure*.

- PDMs 5 through 8 connect to receptacles A through D on PDU 2. *Black* power cords connect these PDMs to the number 2 drive enclosure power supplies and to the *lower controller enclosure*.

IMPORTANT: The locations of the PDUs and the PDMs are the same in all Enterprise racks.

CXO7965A
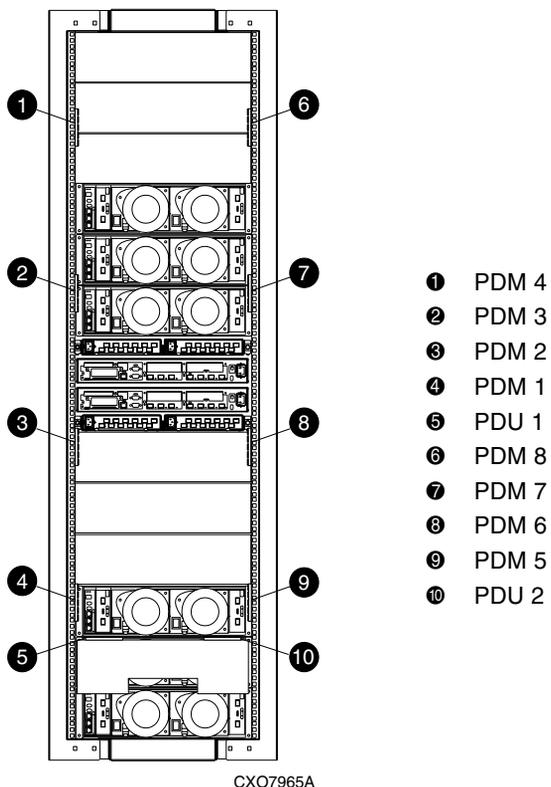
Figure 4–33: Rack AC power distribution

❶	PDM 4
❷	PDM 3
❸	PDM 2
❹	PDM 1
❺	PDU 1
❻	PDM 8
❼	PDM 7
❽	PDM 6
❾	PDM 5
❿	PDU 2

Moving and Stabilizing a Rack

⚠ **WARNING: The physical size and weight of the rack requires a minimum of two people to move. If one person tries to move the rack, injury may occur.**

To ensure stability of the rack, always push on the lower half of the rack. Be especially careful when moving the rack over any bump (for example: door sills, ramp edges, carpet edges, or elevator openings). When the rack is moved over a bump, there is a potential for it to tip over.

Moving the rack requires a clear, uncarpeted pathway that is at least 80 mm (30 in) wide for the 60.3 cm (23.7 in) wide, 42U rack. A vertical clearance of 203.2 cm (80 in) should ensure sufficient clearance for the 200 cm (78.7 in) high, 42U rack.

⚠ **CAUTION:** Ensure that no vertical or horizontal restrictions exist that would prevent rack movement without damaging the rack.

Make sure that all four leveler feet are in the fully raised position. This process will ensure that the casters support the rack weight and the feet do no impede movement.

Each Enterprise Rack requires an area 603 mm (23.7 in) wide and 909 mm (35.8 in) deep (see Figure 4–34).

❶	Front door
❷	Rear door
❸	Rack width 603 mm
❹	Service area width 1206 mm
❺	Rear service area depth 603 mm
❻	Rack depth 909 mm
❼	Front service area depth 603 mm
❽	Total rack depth 1115 mm

CXO7593A
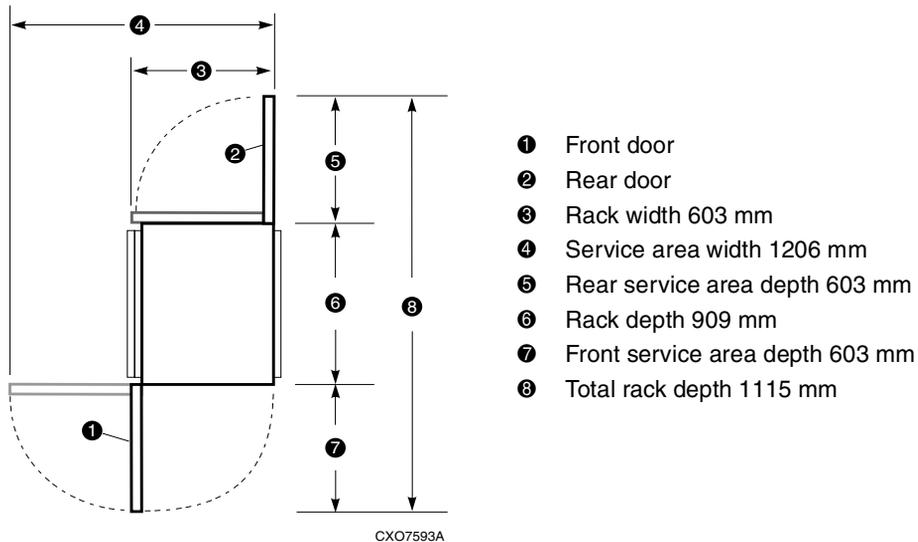
Figure 4–34: Single rack configuration floor space requirements

If the feet are not fully raised, complete the following procedure:

1. Raise one foot by turning the leveler feet hex nut counterclockwise until the weight of the rack is fully on the casters. (see Figure 4–35).

2. Repeat step 1 for the other feet.

❶ Hex nut
❶ Leveler foot
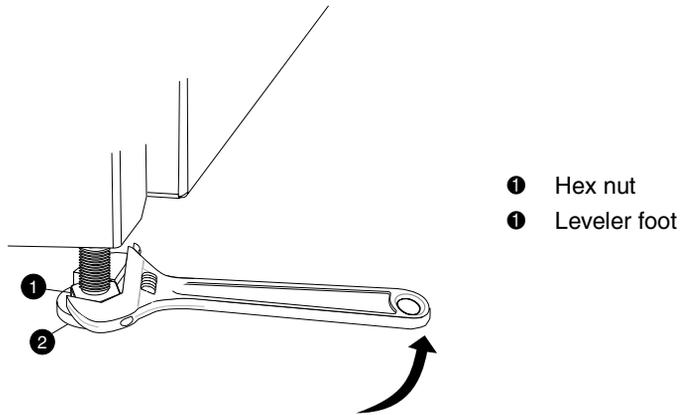
Figure 4–35: Raising a leveler foot

3. Carefully move the rack to the installation area and position it to provide the necessary service areas (see Figure 4–34).

To stabilize the rack when it is in the final installation location:

1. Use a wrench to lower the feet by turning the leveler feet hex nut clockwise until the caster does not touch the floor

2. Repeat step 1 for the other feet.

3. After lowering the feet, check the rack to ensure it is stable and level.

4. Adjust the feet as necessary to ensure the rack is stable and level.

A

Regulatory Notices and Specifications

FCC Class A Certification

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules, which are designed to provide reasonable protection against such radio frequency interference.

Operation of this equipment in a residential area may cause interference, in which case the user at the user's own expense will be required to take whatever measures may be required to correct the interference.

Any modifications to this device—unless approved by the manufacturer—can void the user's authority to operate this equipment under Part 15 of the FCC rules.

IMPORTANT: Additional information on the need to interconnect the device with shielded (data) cables or the need for special devices, such as ferrite beads on cables, is required if such means of interference suppression was used in the qualification test for the device. This information will vary from device to device and needs to be obtained from the Compaq EMC group or the product manager.

Country-Specific Certifications

Compaq tests electronic products for compliance with country-specific regulatory requirements, as an individual item or as part of an assembly. The product label (see Figure A–1) specifies the regulations with which the product complies.

NOTE: Elements without an individual product certification label are qualified as part of the *next higher* assembly (for example, enclosure, rack, or tower).
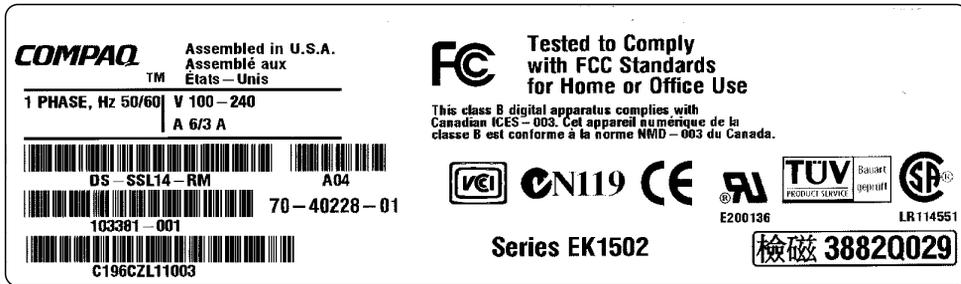
CXO7084A

Figure A–1: Typical enclosure certification label

NOTE: The certification symbols on the label depend upon the certification level. For example, the FCC Class A certification symbol is not the same as the FCC Class B certification symbol.

Fibre Channel Drive Enclosure Specifications

This appendix defines the physical, environmental, and power specifications of the Fibre Channel disk drive enclosure and the elements.

Physical Specifications

This section describes the physical specifications of the drive enclosure and elements.

> ⚠ **CAUTION:** An assembled enclosure (all elements installed) weighs more than 65 lb (29.5 kg) and requires a minimum of two individuals to move.

Table A–1 defines the dimensions and weights of the enclosure.

Table A–1: Drive Enclosure Physical Specifications

			Shipping	
	Empty	**Installed**	**Carton**	**Carton & Pallet**
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.				
Height	131 mm (5.16 in)	131 mm (5.16 in)	641 mm (25.25 in)	768 mm (30.25 in)
Width	505 mm (19.875 in)	505 mm (19.875 in)	318 mm (12.5 in)	610 mm (24 in)

Table A–1: Drive Enclosure Physical Specifications (Continued)

	Empty	Installed	Shipping	
			Carton	Carton & Pallet
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.				
Depth	448 mm (17.625 in)	448 mm (17.625 in)	597 mm (23.5 in)	1016 mm (40 in)
Weight	10.9 kg (24 lb)	30.9 kg (68 lb)	43.6 kg (96 lb)	49 kg (108 lb)

Table A–2 defines the dimensions of the elements (that is, EMU, blowers, I/O module, drives, and power supply).

Table A–2: Drive Enclosure Elements Physical Specifications

Specification	Installed	Shipping Carton
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.		
Environmental Monitoring Unit (EMU)		
Height	114 mm (4.5 in)	210 mm (8.25 in)
Width	241 mm (9.5 in)	330 mm (13.5 in
Depth	35 mm (1.375 in)	108 mm (4.25 in)
Weight	0.6 kg (1.3 lb)	0.91 lb (2.0 lb)
Blower		
Height	140 mm (5.5 in)	191 mm (7.5 in)
Width	159 mm (6.25 in)	203 mm (8.0 in)
Depth	83 mm (3.25 in)	229 mm (9.0 in)
Weight	0.45 kg (1.0 lb)	0.91 kg (2.0 lb)
I/O Module		
Height	114 mm (4.5 in)	210 mm (8.25 in)
Width	41 mm (1.625 in)	108 mm (4.25 in)
Depth	241 mm (9.5 in)	330 mm (13.0 in)
Weight	0.59 kg (1.3 lb)	0.77 kg (1.7 lb)

Table A–2: Drive Enclosure Elements Physical Specifications (Continued)

Specification	Installed	Shipping Carton
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.		
Disk Drive		
Height	114 mm (4.5 in)	216 mm (8.5 in)
Width	26 mm (1.025 in)	114 mm (4.5 in)
Depth	241 mm (9.5 in)	330 mm (13.0 in)
Weight	0.59 kg (1.3 lb)	1.0 kg (2.3 lb)
Power Supply (without blower)		
Height	114 mm (4.5 in)	286 mm (11.25 in)
Width	159 mm (6.25 in)	330 mm (13.0 in)
Depth	241 mm (9.5 in)	419 mm (16.5 in)
Weight	1.82 kg (4.0 lb)	3.86 kg (8.5 lb)

Environmental Specifications

To ensure optimum product operation you must maintain the operational environmental specifications listed in Table A–3. The ambient temperature, that is the enclosure air intake or room temperature, is especially critical.

Table A–3: Environmental Operating Specifications

Ambient temperature: +10 °C to +35 °C (+50 °F to +95 °F) with an average rate of change of 1 °C/hour maximum and a step change of 3 °C or less. Maintaining the *optimum ambient temperature* within the specified range ensures that the internal operating temperatures support the drive manufacturer's MTBF specifications.
Relative humidity: 40% to 60% (noncondensing) with a step change of 10% or less (noncondensing)
Air quality: Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air.
Heat dissipation: 1600 BTUs per hour

When shipping, or placing this product in short term storage, Compaq recommends maintaining the environmental conditions listed in Table A–4.

Table A–4: Environmental Shipping or Short-Term Storage Specifications

Ambient temperature: –40 °C to +66 °C (–40 °F to +151 °F)
Relative humidity: 10% to 80% noncondensing
Altitude: 15,240 m (50,000 ft)

Power Specifications

The input voltage to the drive enclosure power supplies is a function of the country-specific input voltage to Enterprise Storage System rack power distribution units (PDUs). Table A–5 defines the AC input power available to the drive enclosure power supplies.

⚠ **CAUTION:** The AC power distribution within a rack ensures a balanced load to each PDU and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition.

Table A–5: Enterprise Storage System AC Input Line Voltages

Specification	Minimal	Nominal	Maximum
60 Hz Service			
AC Line Frequency	57 Hz	60 Hz	63 Hz
AC Line Voltage–Japan	180 VAC	202 VAC	220 VAC
AC Line Voltage–North America	180 VAC	208 VAC	220 VAC
AC Line Voltage–Europe	208 VAC	240 VAC	254 VAC
50 Hz Service			
AC Line Frequency	47 Hz	50 Hz	53 Hz
AC Line Voltage–Japan	180 VAC	202 VAC	220 VAC
AC Line Voltage–North America	190 VAC	220 VAC	235 VAC
AC Line Voltage–North America	200 VAC	230 VAC	244 VAC
AC Line Voltage–Europe	208 VAC	240 VAC	254 VAC

Table A–6 defines the AC input current and wattage to the power supplies.

Table A–6: AC Input Current and Wattage

Nominal			Maximum	
Input Voltage	**Amps**	**Watts**	**Amps**	**Watts**
60-Hz Input				
100 VAC–JBOD	4.35	436	6.41	641
208 VAC–North America	2.03	419	2.94	609
50-Hz Input				
120 VAC–JBOD	3.59	419	5.27	633
220 VAC–North America	1.92	418	2.78	608
230 VAC–North America	1.92	418	2.78	608
240 VAC–Europe	1.76	416	2.55	607

Table A–7 and Table A–8 define the output voltage and current specifications of the power supply.

Table A–7: Output Voltage and Current Specifications

Specification	Range		
	Minimum	**Nominal**	**Maximum**
+5.1 VDC			
Initial Voltage	+5.13 VDC	+5.18 VDC	+5.23 VDC
Steady state current	1.0 A	N/A	26.0 A
+12.2 VDC (Disk Drive Voltage)			
Initial Voltage	+12.13 VDC	+12,25 VDC	+12.37 VDC
Steady state current	1.0 A	N/A	26.0 A
+12.5 VDC (Blower Voltage)			
Initial Voltage	+12.25 VDC	+12.50 VDC	+12.75 VDC
Steady state current	0.0 A	N/A	2.0 A

Table A–8: Dual Power Supply Configuration Power Specifications

Voltage	Current (A)	Power (W)
Maximum Continuous Current		
+5.1 VDC (with a minimum +12.2 VDC load of 0A) +12.2 VDC (with a minimum +5 VDC load of 4A) +12.5 VDC	26.0 A 28.0 A 2.0 A	132 W 342.0 W 25.0 W
	Total	499.0 W
Maximum Peak Current (Simultaneous Seek Activity)		
+5.1 VDC +12.2 VDC +12.5 VDC	26.0 A 43.0 A 2.0 A	132.0 W 524.0 W 25.0 W
	Total	681.0 W

Fibre Channel Switch Specifications

The Fibre Channel Switch requires a clean, dry environment for normal operation.Table A–9 lists the specifications for the Fibre Channel Switch.

Table A–9: Fibre Channel Switch Specifications

Weight	approximately 7.5 lbs.
Dimensions	8.50 x 1.57 x 16.00 in (W x H x D) **NOTE:** The switch with extender is 21.66 in D
Operating Temperature	0 °C to 40 °C for normal operation (ambient air temperature)
Storage Temperature	-40 °C to 80 °C noncondensing
Power	50 or 60 Hz 100–250 VAC 0.5–0.3 A

HSV Controller Specifications

This section defines the physical, power, and environmental specifications of the HSV Controller enclosure.

Physical Specifications

Table A–10 defines the dimensions of the controller and replaceable units.

Table A–10: HSV Controller Physical Specifications

Specification	Installed	Shipping
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm.		
HSV Controller Enclosure		
Height Width Depth Weight	62 mm (2.45 in) 502 mm (19.75 in) 444 (17.49 in) 10.4 kg (23 lb)	267 mm (10.5 in) 762 mm (30 in) 762 mm (30 in) 12.7 kg (28 lb)
Cache Battery Assembly		
Height Width Depth Weight	57 mm (2.25 in) 184 mm (7.25 in) 83 mm (3.25 in) 1.3 kg (2.8 lb)	108 mm (4.25 in) 324 mm (12.75 in) 162 mm (6.375 in) 1.5 kg (3.4 lb)
Blower		
Height Width Depth Weight	55 mm (2.125 in) 116 mm (4.625 in) 105 mm (4.125 in) 0.4 kg (0.8 lb)	165 mm (6.5 in) 216 mm (8.5 in) 216 mm (8.5 in) 0.92 kg (2 lb)

Power Specifications

Table A–11 and Table A–12 define the HSV Controller power supply input power requirements and output power specifications.

Table A–11: Controller Power Supply AC Power Requirements

AC Input Voltage			Frequency		
Minimum	Nominal	Maximum	Minimum	Nominal	Maximum
180 VAC	202 VAC	220 VAC	47 Hz	50 Hz	53 Hz
	208 VAC		57 Hz	60 Hz	63 Hz
208 VAC	240 VAC	254 VAC			

Table A–12: Controller Power Supply Output Specifications

Voltage Specification	Minimum	Nominal	Maximum
+3.3 VDC			
Output Voltage Steady state current Power	3.23 VDC	3.30 VDC	3.36 VDC 18 A[1] 59.4W
+5.0 VDC			
Output Voltage Steady state current Power	4.90 VDC	5.00 VDC	5.10 VDC 4 A 20.0W
+12.0 VDC			
Output Voltage Steady state current Power	11.4 VDC	12.0 VDC	12.6 VDC 2 A 4.0W
		Total Current **Total Power**	24 A 65.4W

1. +3.3 VDC steady state current requires a minimum 5.0-V load of 1 A.

Environmental Specifications

There are no HSV Controller environmental specifications. See the "Enterprise Rack" environmental specifications for this information in the next section.

Enterprise Rack

Physical Specifications

> **WARNING: The weight of the drive enclosure with the elements installed always requires at least two individuals to move. Compaq recommends using a fork lift or a hand truck to move an enclosure in the shipping container.**

Table A–13 through Table A–16 defines the dimensions and weights of the Enterprise Storage System racks.

Table A–13: Enterprise 42U Storage System Rack Physical Dimensions

	Height in / mm	Width in / mm	Depth in / mm	Max Wt lbs / kg
Enterprise 2C6D	78.75 / 2000.0	23.7 / 602	35.8 / 909	918 / 416
Enterprise 2C12D	78.75 / 2000.0	23.7 / 602	35.8 / 909	1350 / 612
Enterprise 0C6D	78.75 / 2000.0	23.7 / 602	35.8 / 909	818 / 371
Enterprise 0C12D	78.75 / 2000.0	23.7 / 602	35.8 / 909	1250 / 567

Table A–14: Enterprise 42U Storage System Rack Shipping Dimensions

	Height in / mm	Width in / mm	Depth in / mm	Max Wt (with packaging) lbs / kg
Enterprise 2C6D	85.38 / 2169	36.0 / 914	48.0 / 1220	1111 / 504
Enterprise 2C12D	85.38 / 2169	36.0 / 914	48.0 / 1220	1543 / 700
Enterprise 0C6D	85.38 / 2169	36.0 / 914	48.0 / 1220	1011 / 459
Enterprise 0C12D	85.38 / 2169	36.0 / 914	48.0 / 1220	1443 / 654

Table A–15: Enterprise 41U Storage System Rack Physical Dimensions

	Height in / mm	Width in / mm	Depth in / mm	Max Wt lbs / kg
Enterprise 2C6D	78.75 / 2000.0	23.7 / 602	39.1 / 993	917 / 416
Enterprise 2C12D	78.75 / 2000.0	23.7 / 602	39.1 / 993	1349 / 612
Enterprise 0C6D	78.75 / 2000.0	23.7 / 602	39.1 / 993	817 / 371
Enterprise 0C12D	78.75 / 2000.0	23.7 / 602	39.1 / 993	1249 / 567

Table A–16: Enterprise 41U Storage System Rack Shipping Dimensions

	Height in / mm	Width in / mm	Depth in / mm	Max Wt (with packaging) lbs / kg
Enterprise 2C6D	85.38 / 2169	36.0 / 914	48.0 / 1220	1110 / 503
Enterprise 2C12D	85.38 / 2169	36.0 / 914	48.0 / 1220	1542 / 699
Enterprise 0C6D	85.38 / 2169	36.0 / 914	48.0 / 1220	1010 / 458
Enterprise 0C12D	85.38 / 2169	36.0 / 914	48.0 / 1220	1442 / 654

Environmental Specifications

To ensure optimum product operation, you must maintain the operational environmental specifications listed in Table A–17. The ambient temperature (the enclosure air intake or room temperature) is especially critical.

Table A–17: Environmental Operating Specifications

Ambient temperature: +10 °C to +35 °C (+50 °F to +95 °F) with an average rate of change of 1 °C/hour maximum and a step change of 3 °C or less. Maintaining the *optimum ambient temperature* within the specified range ensures that the internal operating temperatures support the drive manufacturer's MTBF specifications.
Relative humidity: 40% to 60% (noncondensing) with a step change of 10% or less (noncondensing).
Air quality: Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air.
Heat dissipation: 12,708 BTUs per hour.

When shipping, or placing this product in short term storage, Compaq recommends maintaining the environmental conditions listed in Table A–18.

Table A–18: Environmental Shipping or Short Term Storage Specifications

Ambient temperature: –40 °C to +66 °C (–40 °F to +151 °F)
Relative humidity: 10% to 80% (noncondensing)
Altitude: 15,240 m (50,000 ft)

Power Specifications

Table A–19 defines the AC power specifications for the Enterprise Storage System PDUs, PDMs, drive enclosure power supplies, and controller enclosure power supplies.

Table A–19: Enterprise Storage System AC Power Specifications

Nominal Input Voltage	Specifications
60-Hz Service	
202 VAC Voltage Range Power Receptacle	**Japan** 180-220 VAC, 57-63Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
208 VAC Voltage Range Power Receptacle	**North America** 180-220 VAC, 57-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30
240 VAC Voltage Range Power Receptacle	**Europe** 208-254 VAC, 57-63 Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
50-Hz Service	
202 VAC Voltage Range Power Receptacle	**Japan** 180-220 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
220 VAC Voltage Range Power Receptacle	**North America** 190-235 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30
230 VAC Voltage Range Power Receptacle	**North America** 200-244 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, NEMA L6-30
240 VAC Voltage Range Power Receptacle	**Europe** 208-254 VAC, 57-63 Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309

The power consumption of an Enterprise Storage System is 3,724 W.

B

EMU Generated Condition Reports

This section provides a description of the EMU generated condition reports that contain the following information:

- Element type (*et*), a hexadecimal number in the range *01* through *FF*.

- Element number (*en*), a decimal number in the range *00* through *99* that defines a probable cause of the problem.

- Error code (*ec*), a decimal number in the range *00* through *99*.

- The recommended corrective action.

IMPORTANT: The conventions used to differentiate between the elements of the condition report are:

- The element type has a period after each character.

- The element number has a period after the second character.

- The error code has no periods.

The EMU can send error messages to the controller for transmission to the HSV Element Manager graphical user interface (GUI). The messages displayed are specific to the HSV Element Manager and are not within the scope of this publication.

This appendix explains the condition report format, correcting problems, and how to identify element types. The error codes are arranged in element type sequence (that is, *0.1., 0.2., 0.3., etc.)*.

Condition Report Format

When the EMU alphanumeric display is Er, there are additional displays that identify the element type, the specific element, and the error code, which defines the possible cause of the problem.

- The first-level display defines the type of element affected with two alphanumeric characters separated by periods such as *0.1.*, *0.2.*, *1.3.*, *F.F.*, and so forth. A disk drive problem would display an element type number of *0.1*.

- The second-level display defines the element affected with a two-digit, decimal number followed by a period. For example, when a bay 6 drive error occurs, the element number display is *06.*; a display of *14.* indicates a bay 14 problem.

- The third-level display defines a specific problem, the error code with a two-digit, decimal number. For example, should the problem be either the installation of an incorrectly configured drive or one that cannot operate at the loop link rate, the display is *01*.

Correcting Errors

Correcting an error may require you to perform a specific set of actions. In some cases, the only available corrective action is to replace the element.

Table B–1 lists the element type codes assigned to the drive enclosure elements. Elements that do not have an active condition report are shaded.

Table B–1: Assigned Element Type Codes

Code	Element
0.1.	Disk Drives (see "Drive Conditions" on page B–6)
0.2.	Power Supplies (see Figure B–1 on page B–7)
0.3.	Blowers (see Figure B–2 on page B–8)
0.4.	Temperature Sensors (see Table B–2 on page 11)
0.6.	Audible Alarm[1]
0.7.	EMU
0.C.	Controller OCP LCD[1]
0.F.	Transceivers (see Figure B–4 on page B–20)
1.0.	Language[1]
1.1.	Communication Port[1]

Table B–1: Assigned Element Type Codes (Continued)

Code	Element
1.2.	Voltage Sensors (see Table B–3 on page 21)
1.3.	Current Sensors (see Table B–3 on page 21)
8.0	Drive Enclosure[1]
8.2.	Drive Enclosure Backplane
8.7.	I/O Modules (see Figure B–5 on page B–24)
F.F.	Host

1. A shaded element does not generate a condition report. However, for any error, you should record the error code. Then, implement the recommended corrective action.

Drive Conditions

The format of a disk drive (see Figure 1–5) condition report is *0.1.en.ec*, where:

- *0.1.* is the disk drive element type number

- *en.* is the two-character disk drive element (see Figure)

- *ec* is the error code

A direct correlation exists between the disk drive element number and the bay number. However, no direct correlation exists between the disk drive bay number and the device FC-AL physical address. The FC-AL physical address is assigned by negotiation during system initialization.

The following sections define the disk drive error codes.

0.1.en.01 CRITICAL Condition—Drive Configuration, or Drive Link Rate

As each drive spins up and comes on-line, the EMU determines if the drive is Fibre Channel compatible and can operate at the link rate (1 Gbps or 2 Gbps) established by the I/O module. If either of these conditions are not met, the EMU issues the condition report *0.1.en.01*.

The corrective actions for these conditions are:

- When the drive is not Fibre-Channel-compatible you must install a Fibre Channel compatible drive or a drive blank.

- When the drive is Fibre-Channel-compatible, the EMU compares the drive link rate with the I/O module link rate, the loop link rate.

If the EMU cannot determine the drive link rate, the EMU activates the drive bypass function 1 minute. During this time the EMU continually checks the drive to determine the link rate.

- If the EMU determines the drive cannot operate at the Fibre Channel link rate set by the I/O module, the drive bypass function ends and the drive is placed on the loop. This does not generate a condition report.

- The EMU issues the condition report *0.1.en.01* when the drive link rate is incompatible with Fibre Channel link rate.

- When the EMU cannot determine drive link rate during the 1-minute drive bypass time, the EMU places the drive on the loop. This process allows the drive to negotiate for an address.

  — If negotiation indicates the link rates are compatible, the EMU rechecks the drive link rate to verify compatibility.

  — If negotiation indicates the link rates are incompatible, an error condition exists and drive loop data transfers stop.

This condition report remains active until the problem is corrected. The problem affects disk drive *en*. Therefore, correction to prevent the possible failure of other elements is not required.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Replace the defective drive with:

   - A Fibre-Channel-compatible drive.

   - A Fibre Channel drive capable of operating at a link rate supported by I/O modules and transceivers.

3. Observe the EMU to ensure the error is corrected.

4. If unable to correct the problem, contact your Compaq Authorized Service Provider.

0.1.en.02 INFORMATION Condition—Drive Missing

The drive is improperly installed or missing. Either option could affect the enclosure air flow and cause an overtemperature condition for another element.

- This error remains active for 1 minute, or until the problem is corrected, *whichever occurs first*.

- Immediate correction is not required. However, correction cannot be delayed indefinitely.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.

2. Remove and install the drive to ensure that it is properly installed.

3. Observe the EMU to ensure the error is corrected.

4. If removing and installing the drive did not correct the problem, install a replacement drive or a drive blank.

5. Observe the EMU to ensure the error is corrected.

6. If unable to correct the problem, contact your Compaq Authorized Service Provider.

0.1.en.03 INFORMATION Condition—Drive Software Lock Active

Some enclosures have a software-activated lock that prevents physically removing a drive while this feature is active. This feature can be activated even when an enclosure does not have a physical lock. Removing a drive when this feature is active generates a condition report. This error remains active for 15 seconds.

No action is required to correct this condition.

0.1.en.04 CRITICAL Condition—Loop A Drive Link Rate Incorrect

The drive is capable of operating at the loop link rate, but is running at a different rate. For example, the drive is operating at 1 Gbps, and the loop is operating at 2 Gbps. Only when the drive is operating at the Fibre Channel link rate established by the I/O module can this drive transfer data.

This error remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Remove and replace the drive in the enclosure.

3. Observe the drive status LEDs to ensure the drive is operational.

4. Observe the EMU to ensure the error is corrected.

5. If removing and replacing the drive did not correct the problem, replace the drive.

6. Observe the drive status LEDs to ensure the drive is operational.

7. Observe the EMU to ensure the error is corrected.

8. If unable to correct the problem, contact your Compaq Authorized Service Provider.

0.1.en.05 CRITICAL Condition—Loop B Drive Link Rate Incorrect

The drive is capable of operating at the loop link rate but is running at a different rate. For example, the drive is operating at 1 Gbps, and the loop is operating at 2 Gbps. Only when the drive is operating at the Fibre Channel link rate established by the I/O module can this drive transfer data.

This error remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Remove and replace the drive in the enclosure.

3. Observe the drive status LEDs to ensure the drive is operational.

4. Observe the EMU to ensure the error is corrected.

5. If removing and replacing the drive did not correct the problem, replace the drive.

6. Observe the drive status LEDs to ensure the drive is operational.

7. Observe the EMU to ensure the error is corrected.

8. If unable to correct the problem, contact your Compaq Authorized Service Provider.

Power Supply Conditions

The format of a power supply condition report is *0.2.en.ec*, where:

- *0.2.* is the power supply element type number
- *en.* is the two-character power supply element number
- *ec* is the error code

Figure B–1 shows the location of power supply 1 ❶, and power supply 2 ❷.

CXO7952A
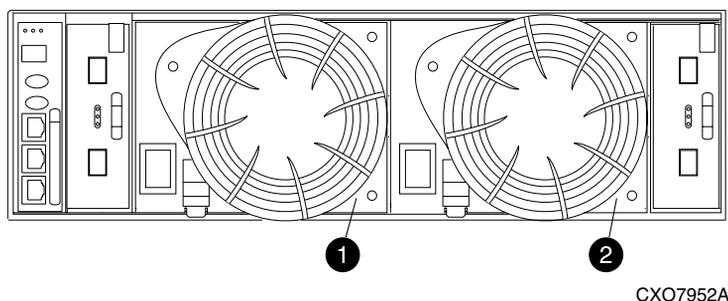
Figure B–1: Power supply element numbering

The following sections define the power supply condition reports.

0.2.en.01 NONCRITICAL Condition—Power Supply AC Input Missing

The loss of the AC input to a power supply makes the remaining supply a single point of failure.

This condition report remains active until AC power is applied to the power supply.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Ensure that there is AC power to the rack PDU, and from the PDU to the PDMs and that the PDU and PDM circuit breakers are not reset.
   If there is no AC power to the PDU, contact building facilities management.
   Verify that the power supply AC power cord is properly connected.

3. If AC is present, and the rack power distribution circuitry is functioning properly, the power supply LED should be on.

4. Observe the EMU to ensure the error is corrected.

5. Contact your Compaq Authorized Service Provider.

0.2.en.02 UNRECOVERABLE Condition—Power Supply Missing

This condition report indicates a power supply is not installed or installed incorrectly. Both of these conditions affect air flow within the enclosure and can cause an overtemperature condition. Enclosure shutdown is imminent.

The operational power supply will automatically shut down after 7 minutes, thereby disabling the enclosure. This condition report remains active until either the problem is corrected, or the operational power supply shuts down, whichever occurs first.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

> **CAUTION:** Removing power from an enclosure may cause the loss or corruption of data. To avoid this condition, shut down the system using the HSV Element Manager.

0.2.en.03 CRITICAL Condition—Power Supply Load Unbalanced

This condition report indicates that a component within a power supply may have failed. This can make the remaining power supply a single point of failure.

This condition report remains active until corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Ensure that the blower on the power supply is functioning properly. If not, correct the blower condition and wait one minute.

3. Contact your Compaq Authorized Service Provider.

Blower Conditions

The format of a blower condition report is *0.3.en.ec*, where:

- *0.3.* is the blower element type number
- *en.* is the two-character blower element number
- *ec* is the error code

As shown in Figure B–2, blower 1 is in location ❶ and blower 2 is in location ❷
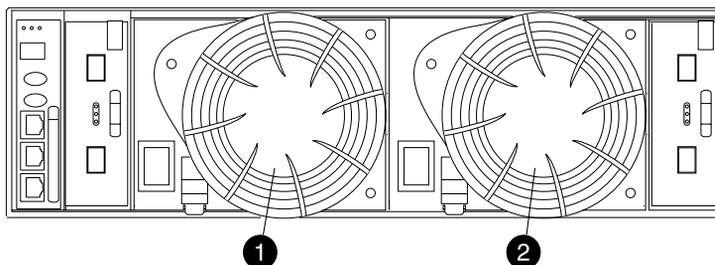
CXO7953A

Figure B–2: Blower element numbering

⚠ **CAUTION:** A single blower operating at high speed can provide sufficient air flow to cool an enclosure and the elements for up to 100 hours. However, operating an enclosure at temperatures approaching an overheating threshold can damage elements and may reduce the MTBF of a specific element. Immediate replacement of the defective blower is required.

The following sections define the power supply condition reports.

0.3.en.01 NONCRITICAL Condition—Blower Speed

A blower is operating a speed outside of the EMU specified range, possibly because of a bearing problem. This can affect enclosure cooling and cause an element to fail. This condition report remains active until the problem is corrected.

This error does not normally require immediate correction. However, an error of this type could contribute to an element overheating.

Compaq recommends replacing the blower as soon as possible.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

0.3.en.02 CRITICAL Condition—Blower Speed

A blower is operating at a speed that is significantly outside the EMU specified range, possibly because of a bearing problem. This can cause the loss of cooling and cause an element to fail. The error remains active until the problem is corrected.

Compaq recommends replacing the blower as soon as possible.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

0.3.en.03 UNRECOVERABLE Condition—Blower Failure

A blower has stopped. The operational blower now operates at high speed and is a single point of failure. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

0.3.en.04 UNRECOVERABLE Condition—Blower Internal

A power supply reported an internal blower error that could affect enclosure cooling and cause an element to fail. Compaq recommends correcting the problem before the blower fails. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

0.3.en.05 NONCRITICAL Condition—Blower Missing

A blower has been removed or is improperly installed. Even though the blower flaps close to maintain the proper air flow, the reduced cooling capability can cause overheating, causing an element to fail. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

0.3.en.06 UNRECOVERABLE Condition—No Blowers Installed

IMPORTANT: When this condition exists there will be two error messages.
The first message will be *0.3.en.05* and will identify the first blower.
The second message will be *0.3.en.06* and will identify the second blower.

The EMU cannot detect any installed blowers. *Shutdown is imminent!* The EMU will shut down the enclosure in *7 minutes* unless you correct the problem. This condition report remains active until you correct the problem or the EMU shuts down the power supplies, whichever occurs first.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.

2. Use the controller shutdown procedure to shut down the controllers.

3. Contact your Compaq Authorized Service Provider.

Temperature Conditions

The format of a temperature condition report is *0.4.en.ec*, where:

- *0.4.* is temperature sensor element type
- *en.* is the two-character temperature sensor element
- *ec* is the error code

Refer to Table B–2 to determine the location of each temperature sensor.

Table B–2: Temperature Sensor Element Numbering

Sensor	Sensor Location	Sensor	Sensor Location
01.	Power Supply 1 Exhaust	10.	Drive Bay ❼
02.	Power Supply 2 Exhaust	11.	Drive Bay ❽
03.	EMU	12.	Drive Bay ❾
04.	Drive Bay ❶	13.	Drive Bay ❿
05.	Drive Bay ❷	14.	Drive Bay ⓫
06.	Drive Bay ❸	15.	drive Bay ⓬
07.	Drive Bay ❹	16.	Drive Bay ⓭
08.	Drive Bay ❺	17.	Drive Bay ⓮
09.	Drive Bay ❻		

The following sections list the temperature condition reports and the default temperature thresholds. Use the HSV Element Manager to view the temperature sensor ranges for the disk drives, EMU, and power supplies.

0.4.en.01 NONCRITICAL Condition—High Temperature

This condition report indicates that an element temperature is approaching, but has not reached, the high temperature CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.

2. Ensure that all elements are properly installed to maintain proper air flow.

3. Ensure that nothing is obstructing the air flow at either the front of the enclosure or the rear of the blower.

4. Ensure that both blowers are operating properly (the LEDs are on) and neither blower is operating at high speed.

5. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.

6. Observe the EMU to ensure the error is corrected.

7. If unable to correct the problem, contact your Compaq Authorized Service Provider.

0.4.en.02 CRITICAL Condition—High Temperature

This condition report indicates that an element temperature is above the high temperature CRITICAL threshold. Continued operation under these conditions may result in element failure and may reduce an element MTBF. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.

2. Ensure that all elements are properly installed to maintain proper air flow.

3. Ensure that nothing is obstructing the air flow at either the front of the enclosure or the rear of the blower.

4. Ensure that both blowers are operating properly (the LEDs are on) and neither blower is operating at high speed.

5. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.

6. Observe the EMU to ensure the error is corrected.

7. If unable to correct the problem, contact your Compaq Authorized Service Provider.

0.4.en.03 NONCRITICAL Condition—Low Temperature

This condition report indicates that an element temperature is approaching, but has not reached, the low temperature CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.

2. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.

3. Observe the EMU to ensure the error is corrected.

4. If the ambient temperature is correct and the problem persists, contact your Compaq Authorized Service Provider.

0.4.en.04 CRITICAL Condition—Low Temperature

This condition report indicates that an element temperature has reached the low temperature CRITICAL threshold. Compaq recommends correcting this error to prevent affecting other elements. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.

2. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.

3. Observe the EMU to ensure the error is corrected.

4. If the ambient temperature is correct and the problem persists, contact your Compaq Authorized Service Provider.

0.4.en.05 UNRECOVERABLE Condition—High Temperature

This condition report indicates that the EMU has evaluated the temperature of the three temperature groups (EMU, disk drives, and power supplies), and determined that the average temperature of two of the three groups exceeds the critical level (use the HSV Element Manager to view the temperature thresholds). Under these conditions the EMU starts a timer that will automatically shut down the enclosure in 7 minutes unless you correct the problem. *Enclosure shutdown is imminent!*

Complete the following procedure to correct this problem.

1. Ensure that all disk drives, I/O modules, and power supply elements are fully seated.

2. Ensure that all blowers are operating properly.

3. Verify that the ambient temperature range is +10 °C to +35 °C (+50 °F to +95 °F). Adjust as necessary.

4. If Steps 1, 2 or 3 did not reveal a problem, use the HSV Element Manager to request the HSV controller to shut down the drive enclosure. Completing this action will halt the drive enclosure data transfers.

5. Contact your Compaq Authorized Service Provider and request assistance.

EMU Conditions

The format of an EMU condition report is *0.7.01.ec*, where:

- *0.7.* is the EMU element type number

- *01.* is the two-character EMU element number

- *ec* is the error code

IMPORTANT: There is only one EMU in a drive enclosure. Therefore, the element number is always 01.

Resetting the EMU

In some cases, the only corrective action for an EMU error is to replace the EMU. Call your Compaq Authorized Service Provider if this action is required. Another option is to reset the EMU using the following procedure.

1. Firmly grasp the EMU mounting handle and pull the EMU partially out of the enclosure.

IMPORTANT: You do not need to remove the EMU from the enclosure, nor to disconnect the cables. You must avoid putting any strain on the cables or connectors.

2. Wait 30 seconds, and then push the EMU in and fully seat the element in the backplane. The EMU should display any enclosure condition report within two minutes.

07.01.01 CRITICAL Condition—EMU Internal Clock

There is an internal EMU clock error that will remain active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.

2. Reset the EMU.

3. If resetting the EMU did not correct the problem, replace the EMU.

4. Observe the EMU to ensure the error is corrected.

5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

07.01.02 UNRECOVERABLE Condition—EMU Interrupted

The Inter-IC (I2C) bus is not processing data and the EMU is unable to monitor or report the status of the elements or enclosures. *IMMEDIATE* corrective action is required to ensure proper enclosure operation. This condition report remains active until the problem is corrected.

Complete the following procedure *NOW* to correct this problem.

1. Record all six characters of the condition report.

2. Reset the EMU.

3. Observe the EMU to ensure the error is corrected.

4. If resetting the EMU did not correct the problem, replace the EMU.

5. If unable to correct the problem, contact your Compaq Authorized Service Provider.

0.7.01.03 UNRECOVERABLE Condition—Power Supply Shutdown

This message only appears on the HSV Element Manager GUI to report a power supply has already shut down. This message can be the result of the controller shutdown command or an EMU or power supply initiated power shutdown.

This message cannot be displayed until after restoration of power. Therefore, there is no corrective action required.

0.7.01.04 INFORMATION Condition—EMU Internal Data

The EMU is unable to collect data for the SCSI-3 Engineering Services (SES) page. This condition report remains active for 15 seconds. The condition report affects only internal EMU operations. There is no degradation of enclosure operations.

The EMU initiates automatic recovery procedures.

If the problem is not automatically corrected after one minute, contact your Compaq Authorized Service Provider.

0.7.01.05 UNRECOVERABLE Condition—Backplane NVRAM

IMPORTANT: Backplane NVRAM errors usually occur during manufacture. At this time they are identified and corrected. They rarely occur during normal operation.

When a backplane NVRAM is not programmed or cannot be read by the EMU, there is no communication with the disk drives. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem.

1. Record all six characters of the condition report.

2. Reset the EMU.

3. Observe the EMU to ensure the error is corrected.

4. If resetting the EMU did not correct the problem, contact your Compaq Authorized Service Provider.

0.7.01.10 NONCRITICAL Condition—NVRAM Invalid Read Data

The data read from the EMU NVRAM is invalid. This error initiates an automatic recovery process. This condition report remains active until the problem is corrected.

If the automatic recovery process does not correct the problem, complete the following procedure.

1. Record all six characters of the condition report.

2. Reset the EMU.

3. Observe the EMU to ensure the error is corrected.

4. If resetting the EMU did not correct the problem, initialize the enclosure by:

   a. Removing power from the enclosure.

   b. Applying power to the enclosure.

5. Observe the EMU to ensure the error is corrected.

6. If initializing the enclosure did not correct the problem, contact your Compaq Authorized Service Provider.

0.7.01.11 NONCRITICAL Condition—EMU NVRAM Write Failure

The EMU cannot write data to the NVRAM. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Reset the EMU.

3. Observe the EMU to ensure the error is corrected.

4. If resetting the EMU did not correct the problem, initialize the enclosure by:

    a. Removing power from the enclosure.

    b. Applying power to the enclosure.

5. Observe the EMU to ensure the error is corrected.

6. If initializing the enclosure did not correct the problem, contact your Compaq Authorized Service Provider.

0.7.01.12 NONCRITICAL Condition—EMU Cannot Read NVRAM Data

The EMU is unable to read data from the NVRAM. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Reset the EMU.

3. Observe the EMU to ensure the error is corrected.

4. If resetting the EMU did not correct the problem, initialize the enclosure by:

    a. Removing power from the enclosure.

    b. Applying power to the enclosure.

5. Observe the EMU to ensure the error is corrected.

6. If initializing the enclosure did not correct the problem, contact your Compaq Authorized Service Provider.

0.7.01.13 UNRECOVERABLE Condition—EMU Load Failure

The EMU Field Programmable Gate Array (FPGA) that controls the ESI bus failed to load information required for EMU operation. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Reset the EMU, then observe the EMU to ensure the error is corrected.

3. If resetting the EMU did not correct the problem, initialize the enclosure by:

   a. Removing power from the enclosure.

   b. Applying power to the enclosure.

4. Observe the EMU to ensure the error is corrected.

5. If initializing the enclosure did not correct the problem, contact your Compaq Authorized Service Provider.

0.7.01.14 NONCRITICAL Condition—EMU Enclosure Address

Either the enclosure address is incorrect or the enclosure has no address. Possible causes include a defective enclosure address bus cable, an incorrectly connected cable, or a defective enclosure address bus JB. This condition report remains active until the problem is corrected.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Remove and reconnect the cable between the address bus JB and the EMU.

NOTE: The EMU display may not display a change in condition for up to 30 seconds.

3. Observe the EMU to ensure the error is corrected.

4. If the problem is not corrected, remove and reinstall the bottom and top terminators, and all the JB-to-JB cables.

5. Observe the EMU to ensure the error is corrected.

6. Reset the EMU, then observe the EMU to ensure the error is corrected.

7. If resetting the EMU did not correct the problem, contact your Compaq Authorized Service Provider.

0.7.01.15 UNRECOVERABLE Condition—EMU Hardware Failure

The EMU is inoperative and must be replaced *NOW*! This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

0.7.01.16 INFORMATION Condition—EMU Internal ESI Data Corrupted

The EMU ESI data is corrupted. This condition does not affect any other element and no action is required.

0.7.01.17 UNRECOVERABLE Condition—Power Shutdown Failure

The power supply did not respond to a controller, EMU, or power supply shut down command. Shutting down the supply is required to prevent overheating.

Complete the following procedure to correct the problem:

1. Record all six characters of the condition report.

2. Move the power cord bail lock ❶, Figure B–3, to the left.

3. Disconnect the AC power cord ❷ from the supply.
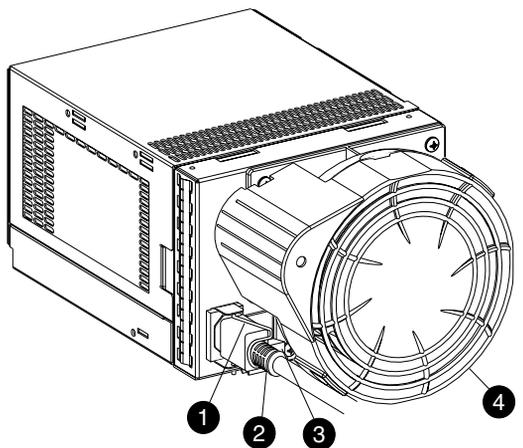
CXO7490A

Figure B–3: Disconnecting AC power

Transceiver Conditions

The format of a transceiver condition report is *0.F.en.ec*, where:

- *0.F.* is the transceiver element type number

- *en.* is the two-character transceiver element number (see Figure B–4)

- *ec* is the error code

CXO7954A
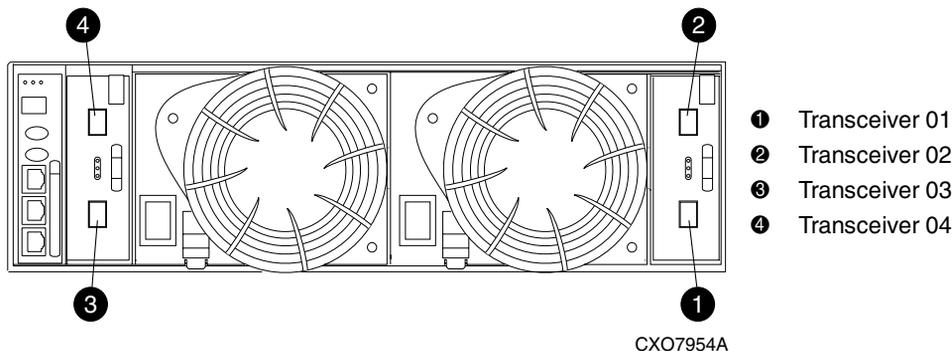
Figure B–4: Transceiver element numbering

0.F.en.01 CRITICAL Condition—Transceiver Incompatibility

The transceiver on this link are not the same type or they are incompatible with the I/O module. This error prevents the controller from establishing a link with the enclosure drives and eliminates the enclosure dual-loop capability. This error remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

0.F.en.02 CRITICAL Condition—Transceiver Data Signal Lost

This symptom can occur when a controller has been powered Off or a cable has been removed from the transceiver. The transceiver can no longer detect a data signal. This error prevents the controller from transferring data on a loop and eliminates the enclosure dual-loop capability. This error remains active until the problem is fixed.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

0.F.en.03 CRITICAL Condition—Transceiver FC-AL Bus Fault

The system has detected an FC-AL bus fault involving a transceiver. This error prevents the controller from transferring data on a loop and eliminates the enclosure dual-loop capability

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Check all the transceivers and cables to ensure they are properly connected.

3. Check all the transceivers on the loop to ensure they are compatible with the I/O module.

4. Contact your Compaq Authorized Service Provider.

Voltage Sensor and Current Sensor Conditions

The format of these sensor condition reports is *1.2.en.ec* for a voltage sensor, and *1.3.en.ec* for a current sensor, where:

- *1.2.* is the voltage sensor element type

- *1.3.* is the current sensor element type number

- *en.* is the sensor element number

- *ec* is the error code

Table B–3 lists the location of the power supply voltage and current sensors.

Table B–3: Voltage and Current Sensor Locations

Sensor	Sensor Element Location
01.	Power Supply 1 +5 VDC
02.	Power Supply 1 +12 VDC
03.	Power Supply 2 +5 VDC
04.	Power Supply 2 +12 VDC

Use the HSV Element Manager to view the voltage and current error thresholds for both +5 VDC and +12 VDC power supplies.

1.2.en.01 NONCRITICAL Condition—High Voltage

This condition report indicates that an element voltage is approaching, but has not reached, the high voltage CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

1.2.en.02 CRITICAL Condition—High Voltage

This condition report indicates that an element voltage has reached the high voltage CRITICAL threshold. This report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

1.2.en.03 NONCRITICAL Condition—Low Voltage

This condition report indicates that an element voltage is approaching, but has not reached, the low voltage CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

1.2.en.04 CRITICAL Condition—Low Voltage

This condition report indicates that an element voltage has reached the low voltage CRITICAL threshold. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

1.3.en.01 NONCRITICAL Condition—High Current

This condition report indicates that an element current is approaching, but has not reached, the high current CRITICAL threshold. Continued operation under these conditions may result in a CRITICAL condition. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

1.3.en.02 CRITICAL Condition—High Current

This condition report indicates that an element current has reached the high current CRITICAL threshold. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

Backplane Conditions

IMPORTANT: Backplane NVRAM errors usually occur during manufacture. At this time they are identified and corrected. They rarely occur during normal operation.

The format of a backplane condition report is *8.2.01.ec*, where:

- *8.2.* is the backplane element type number

- *01.* is the two-character backplane element number

- *ec* is the error code

The only corrective action available for this error is to replace the drive enclosure.

8.2.01.10 NONCRITICAL Condition—Backplane NVRAM Read

An invalid NVRAM read occurred and an automatic recovery process has begun. This condition report is active for 15 seconds.

If the automatic recovery process does not correct the problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

8.2.01.11 NONCRITICAL Condition—Backplane NVRAM Write Failure

The system is unable to write data to the NVRAM. This problem prevents communication between elements in the enclosure. This condition report is active for 15 seconds.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

8.2.01.12 NONCRITICAL Condition—Backplane NVRAM Read Failure

The system is unable to read data from the NVRAM. This problem prevents communication between elements in the enclosure. This condition report is active for 15 seconds.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

8.2.01.13 NONCRITICAL Condition—Backplane WWN Is Blank

The system is unable to read valid data from the NVRAM. This report is active until corrected. This condition can result in incorrect device location data being displayed.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

I/O Module Conditions

The format of an I/O module condition report is *8.7.en.ec*, where:

- *8.7.* is the I/O module element type number
- *en.* is the two-character I/O module element number (see Figure B–5)
- *ec* is the error code

❶ I/O Module A (01)
❷ I/O Module B (02)

CXO7951A
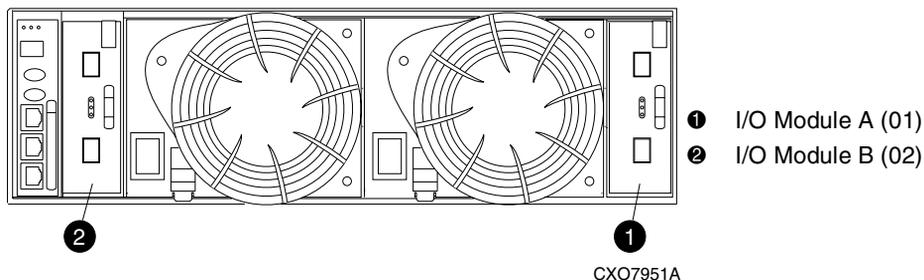
Figure B–5: I/O module element numbering

Correction of an I/O module problem normally requires replacing the module. The following sections define the I/O module problem by I/O module location.

8.7.en.01 CRITICAL Condition—I/O Module Unsupported

The I/O module Fibre Channel link speed is not supported by the backplane. This error prevents the controller from establishing a link with enclosure drives and eliminates the enclosure dual-loop capability. This condition report remains active until the problem is corrected.

To correct this problem, record all six characters of the condition report, then contact your Compaq Authorized Service Provider.

8.7.en.02 CRITICAL Condition—I/O Module Communication

The I/O module is unable to communicate with the EMU.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Contact your Compaq Authorized Service Provider.

IMPORTANT: Multiple erroneous error messages indicating I2C bus errors, such as NVRAM errors, blowers missing, and so forth, could indicate an EMU problem.

8.7.en.10 NONCRITICAL Condition—I/O Module NVRAM Read

An invalid NVRAM read occurred and automatic recover was initiated.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Observe the I/O module status LEDs for a an operational display.

3. Contact your Compaq Authorized Service Provider.

8.7.en.11 NONCRITICAL Condition—I/O Module NVRAM Write

The system is unable to write data to the I/O module NVRAM.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Observe the I/O module status LEDs for a an operational display.

3. contact your Compaq Authorized Service Provider.

8.7.en.12 NONCRITICAL Condition—I/O Module NVRAM Read Failure

The system is unable to read data from the I/O module NVRAM.

Complete the following procedure to correct this problem:

1. Record all six characters of the condition report.

2. Contact your Compaq Authorized Service Provider.

Host Conditions

The EMU has the capability of displaying host controller defined condition reports on the EMU alphanumeric display.

The format of a host condition report is *F.F.en.ec*, where:

- *F.F.* is the host element type number

- *en.* is the two-character host element number

- *ec* is the error code

The host controller can display host controller defined error codes on the EMU alphanumeric display

F.F.en.01 INFORMATION Condition—Host Generated

The host controller (HSV) defines the error type and the affected elements. These messages may be displays on the HSV Element Manager GUI. The proper corrective action depends on the element and error.

C

HSV-Series Controller Fault Management

This appendix descibes how the controller displays events and termination event information. Termination Event information is displayed on the LCD. The HSV Element Manager GUI enables you to view controller events. This appendix also discusses how to identify and correct problems.

Once you create a storage system as described in Chapter 2, "Setting Up an HSV-Series Controller Pair Using the OCP," an error condition message has priority over other controller displays.

The HSV Element Manager GUI provides detailed descriptions of the storage system error conditions, or faults. The Fault Management displays provide similar information on the LCD, but not in as much detail. Whenever possible, refer to the GUI for fault information.

Using the HSV Element Manager GUI

The HSV Element Manager GUI display provides detailed information about each event affecting system operation in either a Termination Event display or an Event display. These displays are similar, but not identical.

GUI Termination Event Display

A problem that generates the Termination Event display prevents the system from performing a specific function or process. You can use the information in this display (see Figure C–1) to diagnose and correct the problem.

IMPORTANT: The major differences between the Termination Event display and the Event Display are:

- The Termination Event display includes a Code Flag field; it does not include the EIP Type field.

- The Event display includes an EIP type field; it does not include a Code Flag field.

- The Event display includes a Corrective Action Code field.

Date	Time	SWCID	Evt No	Code Flag	Description

Figure C–1: GUI Termination Event display

The fields in the Termination Event display include:

- Date—The date the event occurred.

- Time—The time the event occurred.

- SWCID—Software Identification Code. A hexadecimal number in the range 0–FF that identifies the controller software component reporting the event.

- Evt No—Event Number. A hexadecimal number in the range 0–FF that is the software component identification number.

- Code Flag—An internal code that includes a combination of other flags.

- Description—The condition that generated the event. This field may contain information about an individual field's content and validity.

GUI Event Display

A problem that generates the Event display reduces the system capabilities. You can use the information in this display (see Figure C–2) to diagnose and correct problems.

IMPORTANT: The major differences between the Event Display and the Termination Event display are:

- The Event display includes an EIP type field; it does not include a Code Flag field.

- The Event display includes a Corrective Action Code (CAC) field.

- The Termination Event display includes a Code Flag field; it does not include the EIP Type field.

Date	Time	SWCID	Evt No	CAC	EIP Type	Description

Figure C–2: Typical HSV Element Manager Event display

The Event display provides the following information:

- Date—The date the event occurred.

- Time—The time the even occurred.

- SWCID—Software Identification Code. A number in the range 1–256 that identifies the internal firmware module affected.

- Evt No—Event Number. A hexadecimal number in the range 0–FF that is the software component identification number.

- CAC—Corrective Action Code. A specific action to correct the problem.

- EIP Type—Event Information Packet Type. A hexadecimal character that defines the event information format.

- Description—The problem that generated the event.

Fault Management Displays

When you do not have access to the GUI, you can display and analyze termination codes (TCs) on the OCP LCD display. You can then use the event text code document, as described in the section titled "Interpreting Fault Management Information" to determine and implement corrective action. You can also provide this information to the Compaq Authorized Service Provider should you require additional support. This lets the service provider identify the tools and components required to correct the condition in the shortest possible time.

When the Fault Management display is active (Flashing), you can either display the last fault or display detailed information about the last 32 faults reported.

Displaying Last Fault Information

Complete the following procedure to display Last Fault information:

1. When the Fault Management display is active (Flashing), press ▶ to select the Last Fault menu.

```
Last Fault

Detail View
```
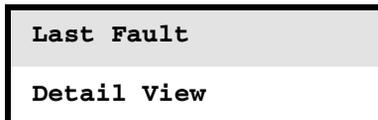
2. Press ▶ to display the last fault information.

```
TC: 0406017F IDX: 00

Param 0:    55555555
```
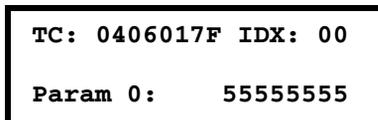
The first line of the TC display contains the eight-character TC error code and the two-character IDX (index) code. The IDX is a reference to the location in the TC array that contains this error.

The second line of the TC display identifies the affected parameter with a two-character parameter number (0–30), the eight-character parameter code affected, and the parameter code number.

3. Press ◀ to return to the Last Fault menu.

Displaying Detailed Information

The **Detail View** menu lets you examine detailed fault information stored in the Last Termination Event Array (LTEA). This array stores information for the last 32 termination events.

Complete the following procedure to display the LTEA information about any of the last 32 termination events:

1. When the Fault Management display is active (Flashing), press ▼ to select the **Detail View** menu.

```
Last Fault

Detail View
```
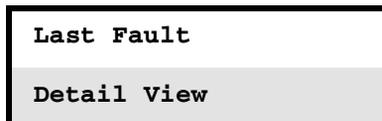
The **LTEA** selection menu is active (LTEA 0 is displayed).

```
DONE

LTEA [0]
```

2. Press ▼ or ▲ to increment to a specific error, LTEA N, in this example.

```
LTEA [N]
```

3. Press ▶ to observe data about the selected error, LTEA N, in this example.

```
TC: XXXXXXXX IDX: xx

Param [N]:   nnnnnnnn
```

Interpreting Fault Management Information

Each version of the HSV Element Manager application includes an ASCII text file that defines all the codes that the Compaq Authorized Service Provider can view either on the GUI or on the OCP.

IMPORTANT: This information is for the exclusive use of the Compaq Authorized Service Provider.

The file name identifies the file type and the revision date. For example, the file name "hsv110_event_w010605_t100.txt" provides the following information:

- `hsv110_`—the Network Storage Controller (NSC) model number string, that is the controller model number

- `event_`—the type information in the file

- `w010605_`—the NSC base level build string, that is, the file creation date

    — `01`—creation year

    — `06`—creation month

    — `05`—creation date

- `t100`—the NSC software version number string

Table C–1 describes types of information available in this file.

Table C–1: Controller Event Text Description File

Information Type	Description
Event Code	This hexadecimal code identifies the reported event type.
Termination Code (TC)	The hexadecimal code specifies the condition that generated the termination code. It may also define either a system or user initiated corrective action.

Table C–1: Controller Event Text Description File (Continued)

Information Type	Description
Coupled Crash Control Codes	These single digit, decimal characters define the requirement for the other controller to initiate a coupled crash control 0. Other controller SHOULD NOT complete a coupled crash. 1. Other controller SHOULD complete a coupled crash.
Dump/Restart Control Codes	This single decimal character (0, 1, 3) defines the requirements to: 0. Perform a crash dump and then restart the controller. 1. DO NOT perform a crash dump; just restart the controller. 3. DO NOT perform a crash dump; DO NOT restart the controller.
Corrective Action Codes (CAC)	These hexadecimal codes supplement the Termination Code information to identify the faulty element and the recommended corrective action.
Software Component ID Codes (SWID)	These decimal codes identify software associated with the event.
Event Information Packets (EIP)	These codes specify the packet organization for specific type event.

D

Customer Replaceable Units

This appendix describes the procedures for replacing CRUs. Information about initial enclosure installation, ESD protection, and common replacement procedures is also presented.

ESD Protection

When you replace a CRU, you must take precautions to prevent the possibility of electrostatic discharge (ESD) damaging sensitive electronic items.

1. *Always* transport and store CRUs in a static-free container.

2. Do not remove the CRU from the static-free container until you are ready to install the CRU.

3. Avoid touching the CRU connector pins, leads, or circuitry.

Common Replacement Procedures

The following procedures are common to all CRU replacement procedures.

> △ **CAUTION:** The hot-pluggable power supplies, blowers, and drives DO NOT require halting Fibre Channel data transfers.
>
> Replacing a pluggable I/O module, transceiver, or a fiber cable always interrupts data transfers on the Fibre Channel loop.
> Review the controller documentation to determine if replacing an I/O module, transceiver or fiber cable requires removing power.

1. Always implement all the ESD protection procedures.

2. Remove the defective CRU from the enclosure.

3. Remove the replacement CRU from the static-free container. Check the label to ensure that the CRU is a compatible replacement (see Figure D–1).

4. Align the CRU with the enclosure guide slots.

5. Slide the CRU into the enclosure until the CRU is against the backplane connector.

6. Fully seat the CRU in the enclosure and verify that the CRU is operating properly.

7. Place the defective CRU in the static-free container for shipment.

Determining CRU Part Numbers

All elements have a Compaq 6–3 spare part number on the product label (see Figure D–1). This nine-character number appears immediately below the REPLACE WITH COMPAQ SPARE statement. The first six characters (123479) identify the element. The last three characters (–002) define the revision level. The replacement element revision level must be the same as, or greater than, the number on the element being replaced. The higher the revision level, the later the revision.

CXO7083A

Figure D–1: Typical Compaq product label

How to Replace a Disk Drive

NOTE: For the latest information and instructions about Compaq disk drives, such as compatibility and installation instructions, go to the Compaq website: http://www.compaq.com.

Complete the following procedure to replace a disk drive.

> ⚠ **CAUTION:** To avoid data loss, remove only one drive at a time to avoid overheating the enclosure. Then, install a drive of equal or greater capacity or a drive blank.

1. Push in on the disk drive Ejector Button ❶ (see Figure D–2), and pivot the Release Lever ❷ to the full, open position.
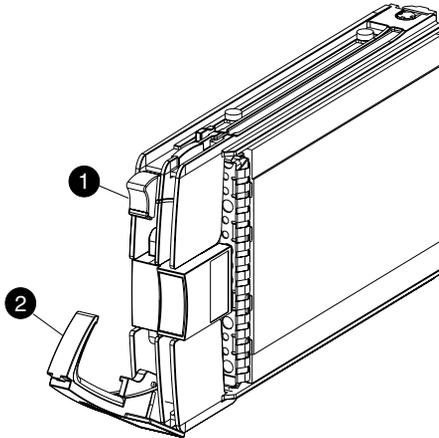
CXO6826A

Figure D–2: Removing a drive

2. Pull on the drive until it disconnects from the backplane connector.

> ⚠ **CAUTION:** The carrier can be dropped due to the rapidly rotating media. To prevent equipment failure, remove the carrier from the enclosure when the media has stopped rotating. This takes approximately 30 seconds.

3. When you are sure that the media is no longer spinning, completely remove the drive from the enclosure.

4. Insert the replacement drive into the enclosure until the drive is against the backplane connector.

5. Push in the replacement drive while pivoting the Release Lever ❷ to the full upright position.

6. Push in the Release Lever until the lever engages the Ejector Button ❶, and the drive fully seats in the backplane connector.

7. Observe the drive status LEDs to ensure the replacement drive is functioning properly. Refer to your drive enclosure user guide for specific details.

How to Install a Drive Blank

Complete the following procedure to replace a disk drive with a drive blank.

1. Push in the disk drive port wine-colored Ejector Button ❶ (see Figure D–3) and pivot the Release Lever ❷ to the full, open position.
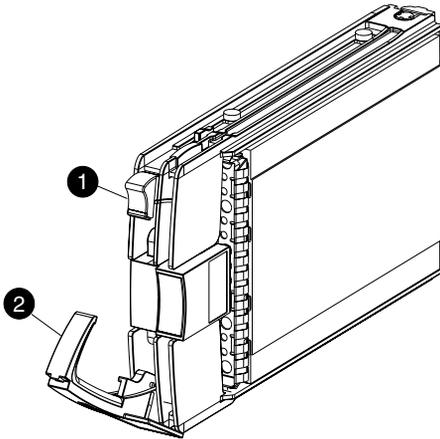
CXO6826A

Figure D–3: Removing a drive to install a drive blank

2. Pull on the drive to disconnect from the backplane connector.

⚠ **CAUTION:** The carrier can be dropped due to the rapidly rotating media. To prevent equipment failure, remove the carrier from the enclosure when the media has stopped rotating. This takes approximately 30 seconds.

---

3. When you are sure that the media is no longer spinning, remove the drive from the enclosure.

4. Insert the drive blank (see Figure D–4) into the enclosure bay until the locking tabs engage the enclosure.

CXO7359A
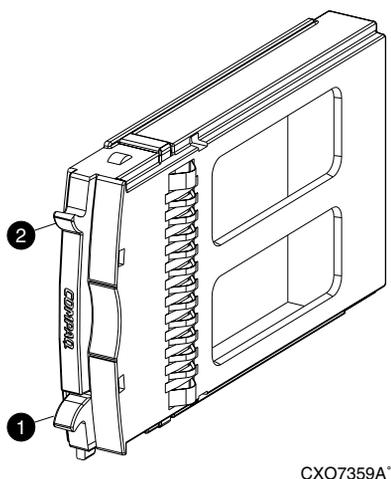
Figure D–4: Installing and removing a drive blank

How to Remove a Drive Blank

Complete the following procedure to remove a drive blank.

1. Grasp the drive blank by the two tabs (❶ and ❷, Figure D–4).

2. Lift up on the bottom tab ❶and pull the blank out of the enclosure.

Protecting Fiber Optic Connections

This section describes the procedures and processes for protecting and cleaning fiber optic connectors.

Contamination of the fiber optic connectors on either a transceiver or a cable connector can impede the transmission of data. Therefore, protecting the connector tips against contamination or damage is imperative. The tips can be contaminated by touching them, by dust, or by debris. They can be damaged when dropped. To protect the connectors against contamination or damage, use the dust covers or dust caps provided by the manufacturer. These covers are removed during installation, and are installed whenever the transceiver or cables are disconnected. Cleaning the connectors should remove contamination.

The transceiver dust caps protect the transceivers from contamination. The transceivers protect the I/O modules from contamination.

> ⚠ **CAUTION:** To avoid damage to the connectors, always install the dust covers or dust caps whenever a transceiver or a fiber cable is disconnected. Remove, *but do not discard*, the dust covers or dust caps from transceiver or fiber cable connectors only when they are connected.

To minimize the risk of contamination or damage, implement the following guidelines:

• **Dust Covers**
Remove *and retain* the dust covers and dust caps when installing an I/O module, a transceiver or a cable. Install the dust covers when disconnecting a transceiver or cable.

• **When to Clean**
Any time you think a connector may be contaminated, or if a connector has not been protected by a dust cover for an extended period of time, clean the connector.

• **How to Clean**

    a. Wipe the connector with a lint-free tissue soaked with 100% isopropyl alcohol.

    b. Wipe the connector with a dry, lint-free tissue.

    c. Dry the connector with moisture-free compressed air.

One of the many sources for cleaning equipment specifically designed for fiber optic connectors is:

Alcoa Fujikura Ltd.
1-888-385-4587 (North America)
011-1-770-956-7200 (International)

Glossary

This glossary defines Enterprise Virtual Array terms used in this publication or related to this product and is not a comprehensive glossary of computer terms.

µm

A symbol for micrometer; one millionth of a meter. For example, 50 µm is equivalent to 0.000050 m.

3U

A unit of measurement representing three "U" spaces. "U" spacing is used to designate panel or enclosure heights. Three "U" spaces is equivalent to 5.25 inches (133 mm).

See also **rack-mounting unit.**

active member of a virtual disk family

An active member of a virtual disk family is a simulated disk drive created by the controllers as storage for one or more hosts. An active member of a virtual disk family is accessible by one or more hosts for normal storage. An active virtual disk member and its snapshot, if one exists, constitute a virtual disk family. An active member of a virtual disk family is the only necessary member of a virtual disk family.

See also **virtual disk, virtual disk copy, virtual disk family,** *and* **snapshot.**

adapter

See **controller.**

AL_PA

Arbitrated Loop Physical Address. A 1-byte value the arbitrated loop topology uses to identify the loop ports. This value becomes the last byte of the address identifier for each public port on the loop.

allocation policy

Storage system rules that govern how virtual disks are created. Allocate Completely and Allocate on Demand are the two rules used in creating virtual disks.

- Allocate Completely—The space a virtual disk requires on the physical disks is reserved, even if the virtual disk is not currently using the space.

- Allocate on Demand—The space a virtual disk requires on the physical disks is not reserved until needed.

ambient temperature

The air temperature in the area where a system is installed. *Also* called intake temperature or room temperature.

ANSI

American National Standards Institute. A non-governmental organization that develops standards (such as SCSI I/O interface standards and Fibre Channel interface standards) used voluntarily by many manufacturers within the United States.

arbitrated loop

A Fibre Channel topology that links multiple ports (up to 126) together on a single shared simplex media. Transmissions can only occur between a single pair of nodes at any given time. Arbitration is the scheme that determines which node has control of the loop at any given moment.

arbitrated loop physical address

See **AL_PA.**

arbitrated loop topology

See **arbitrated loop.**

array

All the physical disk drives in a storage system that are known to and under the control of a controller pair.

array controller

See **controller.**

asynchronous

Events scheduled as the result of a signal requesting the event or that which is without any specified time relation.

audible alarm

The environmental monitoring unit (EMU) alarm that sounds when there is a disk drive enclosure element condition report. The audible alarm can be muted or disabled.

backplane

An electronic printed circuit board that distributes data, control, power, and other signals to element connectors.

bad block

A data block that contains a physical defect.

bad block replacement

A replacement routine that substitutes defect-free disk blocks for those found to have defects. This process takes place in the controller and is transparent to the host.

bail lock

Part of the power supply AC receptacle that engages the AC power cord connector to ensure that the cord cannot be accidentally disconnected.

baud

The maximum rate of signal state changes per second on a communication circuit. If each signal state change corresponds to a code bit, then the baud rate and the bit rate are the same. It is also possible for signal state changes to correspond to more than one code bit so the baud rate may be lower than the code bit rate.

bay

The physical location of an element, such as a drive, I/O module, EMU or power supply in a drive enclosure. Each bay is numbered to define its location.

bidirectional

Also called Bi-Di. The movement of optical signals in opposite directions through a common fiber cable such as the data flow path typically on a parallel printer port. A parallel port can provide two-way data flow for disk drives, scanning devices, FAX operations and even parallel modems.

block

Also called a sector. The smallest collection of consecutive bytes addressable on a disk drive. In integrated storage elements, a block contains 512 bytes of data, error codes, flags, and the block address header.

blower

A variable speed airflow device that pulls air into an enclosure or element. It usually pulls air in from the front and exhausts the heated air out the rear.

cabinet

An alternate term used for a rack.

cable assembly

A fiber optic cable that has connectors installed on one or both ends. General use of these cable assemblies includes the interconnection of multimode fiber optic cable assemblies with either LC or SC type connectors.

- When there is a connector on only one end of the cable, the cable assembly is referred to as a pigtail.

- When there is a connector on both ends of the cable, the cable assembly is referred to as a jumper.

CAC

Corrective Action Code. An HSV Element Manager graphical user interface (GUI) display component that defines the action required to correct a problem.

cache

High-speed memory that sets aside data as an intermediate data buffer between a host and the storage media. The purpose of cache is to improve performance.

See also **read cache, write cache,** *and* **mirrored cache.**

cache battery

A rechargeable unit mounted within a controller enclosure that supplies back-up power to the cache module in case of primary power shortage.

cache battery LED

1.An orange light emitting diode (LED) that illuminates on the controller operator control panel (OCP) to define the status of the HSV Controller cache batteries.

2.An amber status LED that illuminates on a cache battery. When illuminated, it indicates that one or more cache battery cells have failed and the battery must be replaced with a new battery.

carrier

A drive-enclosure-compatible assembly containing a disk drive or other storage devices.

client

A software program that uses the services of another software program. The HSV Element Manager client is a standard internet browser.

clone

See **Virtual Disk Copy**

communication logical unit number (LUN)

See **console LUN.**

condition report

A three-element code generated by the EMU in the form where *e.t.* is the element type (a hexadecimal number), *en.* is the element number (a decimal number), and *ec* is the condition code (a decimal number).

console LUN

A SCSI-3 virtual object that makes a controller pair accessible by the host before any virtual disks are created. *Also* called a communication LUN.

console LUN ID

The ID that can be assigned when a host operating system requires a unique ID. The console LUN ID is assigned by the user, usually when the storage system is initialized.

See also **console LUN.**

controller

A hardware/firmware device that manages communications between host systems and other devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support.

controller enclosure

A unit that holds one or more controllers, power supplies, blowers, cache batteries, transceivers, and connectors.

controller event

A significant occurrence involving any storage system hardware or software component reported by the controller to the HSV Element Manager.

controller fault LED

An amber fault LED that illuminates on the controller OCP to indicate when there is an HSV Controller fault.

controller heartbeat LED

A green LED that flashes on the controller OCP to indicate that the HSV controller is operational.

controller pair

Two interconnected controller modules which together control a physical disk array. A controller pair and the disk array together constitute a storage system.

corrective action code

See **CAC.**

CRITICAL Condition

A disk drive enclosure EMU condition that occurs when one or more disk drive enclosure elements have failed or are operating outside of their specifications. The failure of the element makes continued normal operation of at least some elements in the enclosure impossible. Some enclosure elements may be able to continue normal operations. Only an UNRECOVERABLE condition has precedence. This condition has precedence over NONCRITICAL errors and INFORMATION condition.

CRU

Customer Replaceable Unit. A storage system element that a user can replace without using special tools or techniques, or special training.

customer replaceable unit

See **CRU.**

data entry mode

The state in which controller information can be displayed or controller configuration data can be entered. On the Enterprise Storage System, the controller mode is active when the LCD on the HSV Controller OCP is Flashing.

default disk group

The first disk group created at the time the system in initialized. The default disk group can contain the entire set of physical disks in the array or just a few of the disks.

See also **disk group.**

Detailed Fault View

An HSV Controller OCP display that permits a user to view detailed information about a controller fault.

device channel

A channel used to connect storage devices to a host I/O bus adapter or intelligent controller.

device ports

Controller pair device ports connected to the storage system's physical disk drive array through the FC-AL. *Also* called a device-side port.

device-side ports

See **device ports.**

DIMM

Dual Inline Memory Module. A small circuit board holding memory chips.

dirty data

The write-back cached data that has not been written to storage media even though the host operation processing the data has completed.

disk drive

A carrier-mounted storage device supporting random access to fixed size blocks of data.

disk drive blank

A carrier that replaces a disk drive to control airflow within a drive enclosure whenever there is less than a full complement of storage devices.

disk drive enclosure

A unit that holds storage system devices such as disk drives, power supplies, blowers, I/O modules, transceivers or EMUs.

disk drive enclosure event

A significant operational occurrence involving a hardware or software component in the disk drive enclosure. The disk drive enclosure EMU reports these events to the controller for processing.

disk failure protection

A method by which a controller pair reserves drive capacity to take over the functionality of a failed or failing physical disk. For each disk group, the controllers reserve space in the physical disk pool equivalent to the selected number of physical disk drives.

disk group

A physical disk drive set or pool in which a virtual disk is created. A disk group may contain all the physical disk drives in a controller pair array or a subset of the array.

disk migration state

A physical disk drive operating state. A physical disk drive can be in a stable or migration state:

- Stable—The state in which the physical disk drive has no failure nor is a failure predicted.
- Migration—The state in which the disk drive is failing, or failure is predicted to be imminent. Data is then moved off the disk onto other disk drives in the same disk group.

disk replacement delay

The time that elapses between a drive failure and when the controller starts searching for spare disk space. Drive replacement seldom starts immediately in case the "failure" was a glitch or temporary condition.

drive blank

See **disk drive blank.**

drive enclosure

See **disk drive enclosure.**

dual-loop

A configuration where each drive is connected to a pair of controllers through two loops. These two Fibre Channel loops constitute a loop pair.

dual power supply configuration

See **redundant power configuration.**

EIA

Electronic Industries Alliance. A standards organization specializing in the electrical and functional characteristics of interface equipment.

EIP

Event Information Packet. The event information packet is an HSV element hexadecimal character display that defines how an event was detected. *Also* called the EIP type.

electromagnetic interference

See **EMI.**

electrostatic discharge

See **ESD.**

element

1. In a disk drive enclosure, a device such as an EMU, power supply, disk, blower, or I/O module. The object can be controlled, interrogated, or described by the enclosure services process.

2. In the Compaq Open SAN Manager, a controllable object, such as the Enterprise Storage System.

Element Manager GUI

The graphical user interface (GUI) through which a user can control and monitor a storage system. The HSV Element Manager software can be installed on more than one management appliance in a fabric. Each installation of the HSV Element Manager software is a management agent. The client for the agent is a standard browser.

EMI

Electromagnetic Interference. The impairment of a signal by an electromagnetic disturbance.

EMU

Environmental Monitoring Unit. An element which monitors the status of an enclosure, including the power, air temperature, and blower status. The EMU detects problems and displays and reports these conditions to a user and the controller. In some cases, the EMU implements corrective action.

enclosure

A unit used to hold various storage system devices such as disk drives, controllers, power supplies, blowers, an EMU, I/O modules, or blowers.

enclosure address bus

An Enterprise Storage System bus that interconnects and identifies controller enclosures and disk drive enclosures by their physical location. Enclosures within a reporting group can exchange environmental data. This bus uses junction boxes and cables to assign enclosure numbers to each enclosure. Communications over this bus do not involve the FC-AL bus and are, therefore, classified as out-of-band communications.

enclosure number (En)

One of the vertical rack-mounting positions where the enclosure is located. The positions are numbered sequentially in decimal numbers starting from the bottom of the cabinet. Each disk enclosure has its own enclosure number. A controller pair shares an enclosure number. If the system has an expansion rack, the enclosures in the expansion rack are numbered from 15 to 24, starting at the bottom.

enclosure services

Those services that establish the mechanical environmental, electrical environmental, and external indicators and controls for the proper operation and maintenance of devices with an enclosure as described in the *SES SCSI-3 Enclosure Services Command Set (SES), Rev 8b, American National Standard for Information Services.*

Enclosure Services Interface

See **ESI.**

Enclosure Services Processor

See **ESP.**

Enterprise Virtual Array

The Enterprise Virtual Array is a product that consists of one or more storage systems. Each storage system consists of a pair of HSV controllers and the disk drives they manage. A storage system within the Enterprise Virtual Array can be formally referred to as an Enterprise Storage System, or generically referred to as the storage system.

Enterprise Virtual Array rack

A unit that holds controller enclosures, disk drive enclosures, power distribution supplies, and enclosure address buses that, combined, comprise an Enterprise Storage System solution. *Also* called the Enterprise Storage System rack.

See also **rack.**

environmental monitoring unit

See **EMU.**

error code

The portion of an EMU condition report that defines a problem.

ESD

Electrostatic Discharge. The emission of a potentially harmful static electric voltage as a result of improper grounding.

ESI

Enclosure Services Interface. The SCSI-3 engineering services interface implementation developed for StorageWorks products. A bus that connects the EMU to the drives.

ESP

Enclosure Services Processor. An EMU that implements an enclosure's services process.

event

Any significant change in the state of the Enterprise Storage System hardware or software component reported by the controller to the HSV Element Manager.

See also **controller event, disk drive enclosure event, management agent event,** *and* **termination event.**

Event Information Packet

See **EIP.**

Event Number

See **Evt No.**

Evt No.

Event Number. A sequential number assigned to each Software Code Identification (SWCID) event. It is a decimal number in the range 0-255.

exabyte

A unit of storage capacity that is the equivalent of 2^{60} bytes or 1,152,921,504,606,846,976 bytes. One exabyte is equivalent to 1,024 petabytes.

fabric

A Fibre Channel fabric switch or two or more interconnected Fibre Channel switches allowing data transmission.

fabric port

A port which is capable of supporting an attached arbitrated loop. This port on a loop will have the AL_PA hexadecimal address 00 (loop ID 7E), giving the fabric the highest priority access to the loop. A loop port is the gateway to the fabric for the node ports on a loop.

failover

The process that takes place when one controller assumes the workload of a failed companion controller. Failover continues until the failed controller is operational.

fan

The variable speed airflow device that cools an enclosure or element by forcing ambient air into an enclosure or element and forcing heated air out the other side.

See also **blower.**

Fault Management Code

See **FMC.**

FC-AL

Fibre Channel Arbitrated Loop. The American National Standards Institute's (ANSI) document which specifies arbitrated loop topology operation.

FC HBA

Fibre Channel Host Bus Adapter. An interchangeable term for Fibre Channel adapter.

See also **FCA.**

FCA

Fibre Channel Adapter. An adapter used to connect the host server to the fabric. *Also* called a Host Bus Adapter (HBA) or a Fibre Channel Host Bus Adapter (FC HBA).

See also **FC HBA**

FCC

Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.

FCP

Fibre Channel Protocol. The mapping of SCSI-3 operations to Fibre Channel.

fiber

The optical media used to implement Fibre Channel.

fiber optics

The technology where light is transmitted through glass or plastic (optical) threads (fibers) for data communication or signaling purposes.

fiber optic cable

A transmission medium designed to transmit digital signals in the form of pulses of light. Fiber optic cable is noted for its properties of electrical isolation and resistance to electrostatic contamination.

fibre

The international spelling that refers to the Fibre Channel standards for optical media.

Fibre Channel

A data transfer architecture designed for mass storage devices and other peripheral devices that require very high bandwidth.

Fibre Channel adapter

See **FCA.**

Fibre Channel Loop Switch

An enclosure that provides twelve-port central interconnect for Fibre Channel Arbitrated Loops following the ANSI FC-AL standard.

field replaceable unit

See **FRU.**

flush

The act of writing dirty data from cache to a storage media.

FMC

Fault Management Code. The HSV Element Manager display of the Enterprise Storage System error condition information.

form factor

A storage industry dimensional standard for 3.5-inch (89 mm) and 5.25-inch (133 mm) high storage devices. Device heights are specified as low-profile (1-inch or 25.4 mm), half-height (1.6-inch or 41 mm), and full-height (5.25-inch or 133 mm).

FPGA

Field Programmable Gate Array. A programmable device with an internal array of logic blocks surrounded by a ring of programmable I/O blocks connected together through a programmable interconnect.

frequency

The number of cycles that occur in one second expressed in Hertz (Hz). Thus, 1 Hz is equivalent to one cycle per second.

FRU

Field Replaceable Unit. A hardware element that can be replaced in the field. This type of replacement can require special training, tools, or techniques. Therefore, FRU procedures are usually performed only by an authorized service provider.

Gb

Gigabit. A measurement of the rate at which the transfer of bits of data occurs. Sometimes referred to as Gbps. Nominally, a Gb is a transfer rate of 1,000,000,000 (10^9) bits per second.

For Fibre Channel transceivers or FC loops the Gb transfer rates are:

- 1 Gb is a transmission rate of 1,062,500,000 bits per second.
- 2 Gb is a transmission rate of 2,125,000,000 bits per second.

GB

Gigabyte. A unit of measurement defining either:

- A data transfer rate.

  See also **GBps**

- A storage or memory capacity of 1,073,741,824 (2^{30}) bytes.

GBIC

Gigabit Interface Converter.

See **transceiver.**

Gbps

Gigabits per second. A measurement of the rate at which the transfer of bits of data occurs. Nominally, a Gb is a transfer rate of 1,000,000,000 (10^9) bits per second.

See also **Gb.**

GBps

Gigabytes per second. A measurement of the rate at which the transfer of bytes of data occurs. A GBps is a transfer rate of 1,000,000,000 (10^9) bits per second.

See also **GB.**

Giga (G)

The notation to represent 10^9 or 1 billion (1,000,000,000).

gigabaud

An encoded bit transmission rate of one billion (10^9) bits per second.

gigabit

See **Gb.**

gigabit per second

See **Gbps.**

graphical user interface

See **GUI.**

GUI

Graphical User Interface. Software that displays the status of a storage system and allows its user to control the storage system.

HBA

Host Bus Adapter.

See **FCA.**

host

A computer that runs user applications and uses (or can potentially use) one or more virtual disks created and presented by the controller pair.

Host Bus Adapter

See **FCA.**

host computer

See **host.**

host link LED

The HSV Controller display that indicates the status of the storage system Fibre Channel links.

host ports

A connection point to one or more hosts through a Fibre Channel fabric. A host is a computer that runs user applications and that uses (or can potentially use) one or more of the virtual disks that are created and presented by the controller pair.

host-side ports

See **host ports.**

hot-pluggable

A method of element replacement whereby the complete system remains operational during element removal or insertion. Replacement does not interrupt data transfers to other elements.

HSV Element Manager

See **Element Manager.**

hub

A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. It is used to improve the manageability of physical cables.

I/O module

Input/Output module. The enclosure element that is the FC-AL interface to the host or controller. I/O modules are bus speed specific; either 1 Gb or 2 Gb.

IDX

A 2-digit decimal number portion of the HSV controller termination code display that defines one of 32 locations in the Termination Code array that contains information about a specific event.

See also **param** and **TC.**

in-band communication

The method of communication between the EMU and controller that utilizes the FC-AL bus.

See also **out-of-band communication.**

INFORMATION condition

A disk drive enclosure EMU condition report that may require action. This condition is for information only and does not indicate the failure of an element. All condition reports have precedence over an INFORMATION condition.

initialization

A process that prepares a storage system for use. Specifically, the system binds controllers together as an operational pair and establishes preliminary data structures on the disk array. Initialization also sets up the first disk group, called the default disk group.

input/output module

See **I/O module.**

intake temperature

See **ambient temperature.**

interface

A set of protocols used between components such as cables, connectors, and signal levels.

JBOD

Just a Bunch of Disks. A number of disks connected to one or more controllers.

just a bunch of disks

See **JBOD.**

K

Kilo. A scientific notation denoting a multiplier of one thousand (1,000).

KB

Kilobyte. A unit of measurement defining either storage or memory capacity.

1. For storage, a KB is a capacity of 1,000 (10^3) bytes of data.
2. For memory, a KB is a capacity of 1,024 (2^{10}) bytes of data.

LAN

Local area network. A group of computers and associated devices that share a common communications line and typically share the resources of a single processor or server within a small geographic area.

laser

A device that amplifies light waves and concentrates them in a narrow, very intense beam.

Last Fault View

An HSV Controller display defining the last reported fault condition.

Last Termination Error Array

See **LTEA.**

LCD

Liquid Crystal Display. The indicator on a panel that is associated with an element. The LCD is usually located on the front of an element.

LED

Light Emitting Diode. A semiconductor diode, used in an electronic display, that emits light when a voltage is applied to it.

License Key

A WWN-encoded sequence that is obtained from the Compaq license key fulfillment website.

light emitting diode

See **LED.**

link

A connection between ports on Fibre Channel devices. The link is a full duplex connection to a fabric or a simplex connection between loop devices.

logon

Also called login, it is a procedure whereby a user or network connection is identified as being an authorized network user or participant.

loop

See **arbitrated loop.**

loop ID

Seven-bit values numbered contiguously from 0 to 126 decimal and represent the 127 valid AL_PA values on a loop (not all 256 hexadecimal values are allowed as AL_PA values per FC–AL).

loop pair

A Fibre Channel attachment between a controller and physical disk drives. Physical disk drives connect to controllers through paired Fibre Channel arbitrated loops. There are two loop pairs, designated loop pair 1 and loop pair 2. Each loop pair consists of two loops (called loop A and loop B) that operate independently during normal operation, but provide mutual backup in case one loop fails.

LTEA

Last Termination Event Array. A two-digit HSV Controller number that identifies a specific event that terminated an operation. Valid numbers range from 00 to 31.

LUN

Logical Unit Number. A SCSI convention used to identify elements. The host sees a virtual disk as a LUN. The LUN address a user assigns to a virtual disk for a particular host will be the LUN at which that host will see the virtual disk.

management agent

The HSV Element Manager software that controls and monitors the Enterprise Storage System. The software can exist on more than one management appliance in a fabric. Each installation of the HSV Element Manager software is a management agent.

management agent event significant occurrence to or within the management agent software, or an initialized storage cell controlled or monitored by the management agent.

Mb

Megabit. A term defining a data transfer rate.

See also **Mbps.**

MB

Megabtye. A term defining either:

• A data transfer rate.

 See also **MBps.**

• A measure of either storage or memory capacity of 1,048,576 (2^{20}) bytes.

Mbps

Megabits per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 (10^6) bits per second.

MBps

Megabytes per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 (10^6) bytes per second.

mean time between failures

See **MTBF.**

Mega

A notation denoting a multiplier of 1 million (1,000,000).

metadata

Information that a controller pair writes on the disk array. This information is used to control and monitor the array and is not readable by the host.

micro meter

See **µm.**

mirrored caching

A process in which half of each controller's write cache mirrors the companion controller's write cache. The total memory available for cached write data is reduced by half, but the level of protection is greater.

mirroring

The act of creating an exact copy or image of data.

MTBF

Mean Time Between Failures. The average time from start of use to first failure in a large population of identical systems, components, or devices.

multi-mode fiber

A fiber optic cable with a diameter large enough (50 microns or more) to allow multiple streams of light to travel different paths from the transmitter to the receiver. This transmission mode enables bidirectional transmissions.

Network Storage Controller

See **NSC.**

NONCRITICAL Condition

A disk drive enclosure EMU condition report that occurs when one or more elements inside the enclosure have failed or are operating outside of their specifications. The failure does not affect continued normal operation of the enclosure. All devices in the enclosure continue to operate according to their specifications. The ability of the devices to operate correctly may be reduced if additional failures occur. UNRECOVERABLE and CRITICAL errors have precedence over this condition. This condition has precedence over INFORMATION condition. Early correction can prevent the loss of data.

node port

A device port that can operate on the arbitrated loop topology.

non-OFC (Open Fibre Control)

A laser transceiver whose lower-intensity output does not require special open Fibre Channel mechanisms for eye protection. The Enterprise Storage System transceivers are non-OFC compatible.

NSC

Network Storage Controller. The HSV Controllers used by the Enterprise Storage System.

NVRAM

Nonvolatile Random Access Memory. Memory whose contents are not lost when a system is turned Off or if there is a power failure. This is achieved through the use of UPS batteries or implementation technology such as flash memory. NVRAM is commonly used to store important configuration parameters.

occupancy alarm level

A percentage of the total disk group capacity in blocks. When the number of blocks in the disk group that contain user data reaches this level, an event code is generated. The alarm level is specified by the user.

OCP

Operator Control Panel. The element that displays the controller's status using LEDs and an LCD. Information selection and data entry is controlled by the OCP pushbuttons.

operator control panel

See **OCP.**

OSM

Open SAN Manager. A centralized, appliance-based monitoring and management interface that supports multiple applications, operating systems, hardware platforms, storage systems, tape libraries and SAN-related interconnect devices. It is included and resides on the SANWorks Management Appliance, a single aggregation point for data management.

param

That portion of the HSV controller termination code display that defines:

- The 2-character parameter identifier that is a decimal number in the 0 through 30 range.
- The 8-character parameter code that is a hexadecimal number.

See also **IDX** and **TC.**

password

A security interlock where the purpose is to allow:

- A management agent control only certain storage systems
- Only certain management agents control a storage system

PDM

Power Distribution Module. A thermal circuit breaker equipped power strip that distribute power from a PDU to Enterprise Storage System elements.

PDU

Power Distribution Unit. The rack device that distributes conditioned AC or DC power within a rack.

petabyte

A unit of storage capacity that is the equivalent of 2^{50}, 1,125,899,906,842,624 bytes or 1,024 terabytes.

physical disk

A disk drive mounted in a disk drive enclosure that communicates with a controller pair through the device-side Fibre Channel loops. A physical disk is hardware with embedded software, as opposed to a virtual disk, which is constructed by the controllers. Only the controllers can communicate directly with the physical disks.

The physical disks, in aggregate, are called the array and constitute the storage pool from which the controllers create virtual disks.

physical disk array

See **array**.

port

A Fibre Channel connector on a Fibre Channel device.

port_name

A 64-bit unique identifier assigned to each Fibre Channel port. The port_name is communicated during the login and port discovery processes.

port-wine colored

A Compaq convention of applying the color of port wine to a CRU tab, lever, or handle to identify the unit as hot-pluggable.

power distribution module

See **PDM.**

power distribution unit

See **PDU.**

power supply

An element that develops DC voltages for operating the storage system elements from either an AC or DC source.

preferred address

An AL_PA which a node port attempts to acquire during loop initialization.

preferred path

A preference for which controller of the controller pair manages the virtual disk. This preference is set by the user through the element manager when creating the virtual disk. A host can change the preferred path of a virtual disk at any time. The primary purpose of preferring a path is load balancing.

protocol

The conventions or rules for the format and timing of messages sent and received.

pushbutton

A switch that is engaged or disengaged when it is pressed.

quiesce

The act of rendering bus activity inactive or dormant. For example, "quiesce the SCSI bus operations during a device warm-swap."

rack

A floor-standing structure primarily designed for, and capable of, holding and supporting storage system equipment. All racks provide for the mounting of panels per Electronic Industries Alliance (EIA) *Standard RS-310-C*.

rack-mounting unit

A measurement for rack heights based upon a repeating hole pattern. It is expressed as "U" spacing or panel heights. Repeating hole pattern are spaced every 1.75 inches (44.45 mm) and based on EIA's *Standard RS-310-C*. For example, a 3U unit is 5.25-inches (133.35 mm) high, and a 4U unit is 7.0-inches (177.79 mm) high.

read caching

A cache method used to decrease subsystem response times to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives. Reading data from cache memory is faster than reading data from a disk. The read cache is specified as either On or Off for each virtual disk. The default state is on.

read ahead caching

A cache management method used to decrease the subsystem response time to a read request by allowing the controller to satisfy the request from the cache memory rather than from the disk drives.

reconstruction

The process of regenerating the contents of a failed member data. The reconstruction process writes the data to a spare set disk and incorporates the spare set disk into the mirrorset, striped mirrorset or RAID set from which the failed member came.

redundancy

1. Element Redundancy—The degree to which logical or physical elements are protected by having another element that can take over in case of failure. For example, each loop of a device-side loop pair normally work independently but can take over for the other in case of failure.

2. Data Redundancy—The level to which user data is protected. Redundancy is directly proportional to cost in terms of storage usage; the greater the level of data protection, the more storage space is required.

redundant power configuration

A capability of the Enterprise Storage System racks and enclosures to allow continuous system operation by preventing single points of power failure.

• For a rack, two AC power sources and two power conditioning units distribute primary and redundant AC power to enclosure power supplies.

• For a controller or disk drive enclosure, two power supplies ensure that the DC power is available even when there is a failure of one supply, one AC source, or one power conditioning unit. Implementing the redundant power configuration provides protection against the loss or corruption of data.

reporting group

An Enterprise Storage System controller pair and the associated disk drive enclosures. The Enterprise Storage System controller assigns a unique decimal reporting group number to each EMU on its loops. Each EMU collects disk drive environmental information from its own sub-enclosure and broadcasts the data over the enclosure address bus to all members of the reporting group. Information from enclosures in other reporting groups is ignored.

room temperature

See **ambient temperature.**

SANWorks by Compaq HSV Element Manager

See **HSV Element Manager.**

SCSI

1. Small Computer System Interface. An American National Standards Institute (ANSI) interface which defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of 16 bus elements.

2. The communication protocol used between a controller pair and the hosts. Specifically, the protocol is FC-AL or SCSI on a Fibre Channel. SCSI is the higher command-level protocol and Fibre Channel is the low-level transmission protocol. The controllers have full support for SCSI-2; additionally, they support some elements of SCSI-3.

SCSI-3

The ANSI standard that defines the operation and function of Fibre Channel systems.

SCSI-3 Enclosure Services

See **SES.**

selective presentation

The process whereby a controller presents a virtual disk only to the host computer authorized access.

serial transmission

A method of transmission in which each bit of information is sent sequentially on a single channel rather than simultaneously as in parallel transmission.

SES

SCSI-3 Enclosures Services. Those services that establish the mechanical environment, electrical environment, and external indicators and controls for the proper operation and maintenance of devices within an enclosure.

small computer system interface

See **SCSI.**

Snapclone

A virtual disk that can be manipulated while the data is being copied. Only an Active member of a virtual disk family can be snapcloned.

The Snapclone, like a snapshot, reflects the contents of the source virtual disk at a particular point in time. Unlike the snapshot, the Snapclone is an actual clone of the source virtual disk and immediately becomes an independent Active member of its own virtual disk family.

snapshot

A temporary virtual disk (VD) that reflects the contents of another virtual disk at a particular point in time. A snapshot operation is only done on an active virtual disk. Only one snapshot of an active virtual disk can exist at any point. The active disk and its snapshot constitute a virtual family.

See also **active virtual disk, virtual disk copy,** *and* **virtual disk family.**

SSN

Storage System Name. An HSV Element Manager-assigned, unique 20-character name that identifies a specific storage system.

StorageWorks by Compaq

The Compaq trademarked name used to describe the set of rack-mounted enclosures containing controllers, transceivers, I/O modules, EMUs, disk drives, cables, blowers, and power supplies used to design and configure a solution-specific storage system.

storage carrier

See **carrier.**

storage pool

The aggregated blocks of available storage in the total physical disk array.

storage system

The controllers, storage devices, enclosures, cables, and power supplies and their software.

Storage System Name

See **SSN.**

switch

An electro-mechanical device that initiates an action or completes a circuit.

TB

Terabyte. A term defining either:

- A data transfer rate.

  See also **TBps.**

- A measure of either storage or memory capacity of 1,099,5111,627,776 (2^{40}) bytes.

TBps

Terabytes per second. A data transfer rate of 1,000,000,000,000 (10^{12}) bytes per second.

TC

Termination Code. An Enterprise Storage System controller 8-character hexadecimal display that defines a problem causing controller operations to halt.

See also **IDX** and **param.**

Termination Code

See **TC.**

termination event

Occurrences that cause the storage system to cease operation.

terminator

Interconnected elements that form the ends of the transmission lines in the enclosure address bus.

topology

An interconnection scheme that allows multiple Fibre Channel ports to communicate. Point-to-point, arbitrated loop, and switched fabric are all Fibre Channel topologies.

transceiver

The device that converts electrical signals to optical signals at the point where the fiber cables connect to the FC elements such as hubs, controllers, or adapters. *Also* called a Gigabit Interface Converter (GBIC).

uninitialized system

A state in which the storage system is not ready for use.

See also **initialization.**

units

See **rack-mounting units.**

UNRECOVERABLE Condition

A disk drive enclosure EMU condition report that occurs when one or more elements inside the enclosure have failed and have disabled the enclosure. The enclosure may be incapable of recovering or bypassing the failure and will require repairs to correct the condition.

This is the highest level condition and has precedence over all other errors and requires immediate corrective action.

unwritten cached data

Also called unflushed data.

See also **dirty data.**

UPS

Uninterruptible Power Supply. A battery-operated power supply guaranteed to provide power to an electrical device in the event of an unexpected interruption to the primary power supply. Uninterruptible power supplies are usually rated by the amount of voltage supplied and the length of time the voltage is supplied.

VCS

Virtual Controller Software. Provides storage controller software capability for the HSV Controller.

VD

Virtual Disk. A simulated disk drive created by the controllers as storage for one or more hosts. The virtual disk characteristics, chosen by the storage administrator, provide a specific combination of capacity, availability, performance, and accessibility. A controller pair simulates the characteristics of the virtual disk by deploying the disk group from which the virtual disk was created.

The host computer sees the virtual disk as "real," with the characteristics of an identical physical disk.

See also **active virtual disk, virtual disk copy, virtual disk family,** *and* **virtual disk snapshot**

virtual disk

See **VD.**

virtual disk copy

A clone or exact replica of another virtual disk at a particular point in time. Only an active virtual disk can be copied. A copy immediately becomes the active disk of its own virtual disk family.

See also **active virtual disk, virtual disk family,** *and* **virtual disk snapshot**

virtual disk family

A virtual disk and its snapshot, if a snapshot exists, constitute a family. The original virtual disk is called the active disk. When you first create a virtual disk family, the only member is the active disk.

See also **active virtual disk, virtual disk copy,** *and* **virtual disk snapshot.**

virtual disk snapshot

See **snapshot.**

Vraid0

A virtualization technique that provides no data protection. Data host is broken down into chunks and distributed on the disks comprising the disk group from which the virtual disk was created. Reading and writing to a Vraid0 virtual disk is very fast and makes the fullest use of the available storage, but there is no data protection (redundancy) unless there is parity.

Vraid1

A virtualization technique that provides the highest level of data protection. All data blocks are mirrored or written twice on separate physical disks. For read requests, the block can be read from either disk, which can increase performance. Mirroring takes the most storage space because twice the storage capacity must be allocated for a given amount of data.

Vraid5

A virtualization technique that uses parity striping to provide moderate data protection. Parity is a data protection mechanism for a striped virtual disk. A striped virtual disk is one where the data to and from the host is broken down into chunks and distributed on the physical disks comprising the disk group in which the virtual disk was created. If the striped virtual disk has parity, another chunk (a parity chunk) is calculated from the set of data chunks and written to the physical disks. If one of the data chunks becomes corrupted, the data can be reconstructed from the parity chunk and the remaining data chunks.

World Wide Name

See **WWN.**

write back caching

A controller process that notifies the host that the write operation is complete when the data is written to the cache. This occurs before transferring the data to the disk. Write back caching improves response time since the write operation completes as soon as the data reaches the cache. As soon as possible after caching the data, the controller then writes the data to the disk drives.

write caching

A process when the host sends a write request to the controller, and the controller places the data in the controller cache module. As soon as possible, the controller transfers the data to the physical disk drives.

WWN

World Wide Name. A unique Fibre Channel identifier consisting of a 16-character hexadecimal number. A WWN is required for each Fibre Channel communication port.

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