SIOS Protection Suite for Linux
LVM Recovery Kit
v9.2.1

Administration Guide

December 2017

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Chapter 1: Introduction

LVM Recovery Kit Technical Documentation

The SIOS Protection Suite (SPS) for Linux Logical Volume Manager (LVM) Recovery Kit provides logical volume support for other SPS Recovery Kits. Thus, SPS-protected applications can take advantage of the benefits offered by the Logical Volume Manager, including simplified storage management and the ability to dynamically re-size volumes as needs change.

The LVM Recovery Kit is different from most other SPS Recovery Kits in that it is never used alone but always as a dependency of another SPS resource. As such, many of the operations typically associated with an SPS Recovery Kit – for example, creating a hierarchy – are not directly applicable to the LVM Recovery Kit.

Document Contents

This guide explains the following topics:

- Documentation and References. Provides a list of related SPS for Linux documents and where to find them, along with references to a number of helpful documents about the LVM product.

- Requirements. Describes the hardware and software necessary to properly set up, install and operate the LVM Recovery Kit. Refer to the SPS for Linux Installation Guide for specific instructions on how to install or remove the SPS for Linux software.

- Overview. Provides a general description of the LVM Recovery Kit and corresponding resource types.

- SPS LVM Hierarchy Creation and Administration. Includes a detailed description of LVM Recovery Kit administration tasks through SPS.

- Troubleshooting. Provides a list of informational and error messages with recommended solutions.

Documentation and References

The following is a list of SPS related information available from SIOS Technology Corp.:

- SPS for Linux Release Notes

- SPS for Linux Technical Documentation

- SIOS Protection Suite Installation Guide

- Optional Recovery Kit Documentation

This documentation, along with documentation associated with other SPS Recovery Kits, is available online at:

http://docs.us.sios.com/

For information on LVM, refer to:

RedHat: https://access.redhat.com/documentation/en-US/Red_Hat_Enterprise_Linux/6/html/Logical_Volume_Manager_Administration/index.html

SUSE: https://www.suse.com/documentation/sles11/stor_admin/data/lvm.html

LVM HowTo: http://www.tldp.org/HOWTO/LVM-HOWTO/index.html (This document is out-of-date)

Chapter 2: Requirements

Your SPS configuration must meet the following requirements prior to the installation of the SPS for Linux LVM Recovery Kit. Please see the SIOS Protection Suite Installation Guide for specific instructions regarding the configuration of your SPS for Linux hardware and software.

Hardware Requirements

- **Servers**. This recovery kit requires two or more computers configured in accordance with the requirements described in the SPS for Linux Release Notes and the SPS for Linux Installation Guide, which are shipped with the product media.

- **Data Storage**. The LVM Recovery Kit can be used in conjunction both with shared storage and with replicated storage provided by the DataKeeper for Linux product. It cannot be used with network attached storage (NAS). Otherwise, the kit has no specific requirements on storage configurations beyond the requirements of the recovery kit protecting the application sitting on top of the logical volume (s).

Software Requirements

- **Operating System**. LVM is included in all major Linux distributions. See the SPS for Linux Release Notes for a list of supported distributions and LVM versions.

- **Logical Volume Manager**. The recovery kit installation requires that the `lvm` or`lvm2` rpm package be installed. This release of the SPS Logical Volume Manager Recovery Kit supports both LVM Version 1 and LVM Version 2 (LVM2). The specific versions of LVM supported are those delivered by the Linux distributions.

- **SPS Software**. You must install the same version of SPS core software and any recovery kits including the LVM Recovery Kit and any patches on each server. Please refer to the SPS for Linux Release Notes for specific SPS requirements.

- **SPS for Linux Logical Volume Manager Recovery Kit**. The Logical Volume Manager Recovery Kit is provided on the SPS Installation Image File (sps.img). It is packaged, installed and removed via the Red Hat Package Manager, rpm: `steeleye-lkLVM`.

During package installation, checks are made to ensure that supported versions of both the SPS Core package and the LVM package are present on the system where the LVM Recovery Kit is being installed. The SPS for Linux Release Notes contains information on the required versions of these packages.

Refer to the SPS for Linux Installation Guide for instructions on how to install or remove the SPS Core software and the LVM Recovery Kit.

The LVM Recovery Kit must be installed on each server in the cluster on which LVM is being used to manage disk resources that are to be protected by SPS.

The LVM Recovery Kit must be installed prior to the hierarchy creation and extension of applications that sit on top of an LVM volume.

Chapter 3: Overview

LVM Operation

LVM is currently the standard volume management product included with all of the major Linux distributions. LVM allows multiple physical disks and/or disk partitions to be grouped together into entities known as volume groups. Volume groups may then be divided or partitioned into logical volumes. Logical volumes are accessed as regular block devices and as such may be used by file systems or any application that can operate directly with a block device.

Logical volume managers are principally used to simplify storage management. Logical volumes can be resized dynamically as storage requirements change, and volume groups and logical volumes can be sensibly named with identifiers chosen by the administrator rather than physical disk or partition names such as `sda` or `sdc1`.

The following diagram shows the relationship of the LVM entities. File systems or applications use logical volumes. Logical volumes are created by partitioning volume groups. Volume groups consist of the aggregation of one or more physical disk partitions or disks.
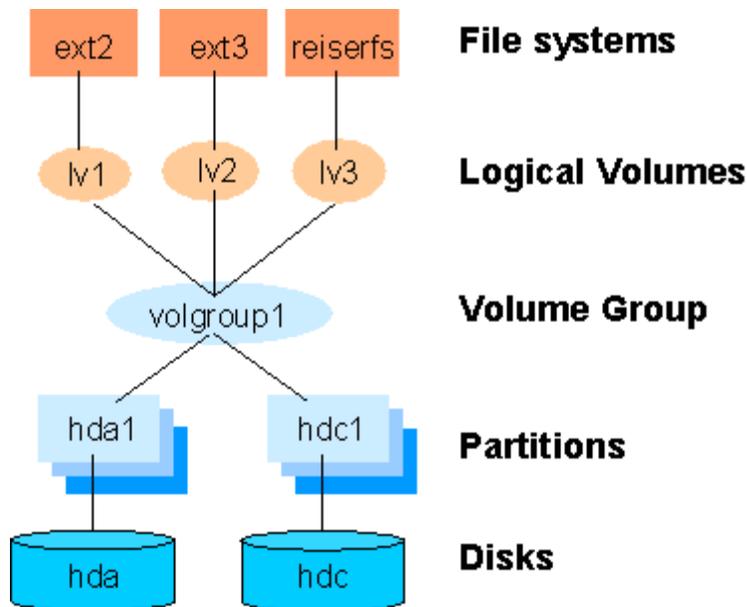
Figure 1: Logical Volume Manager Entity Relationships

SPS for Linux LVM Recovery Kit

The SPS LVM Recovery Kit provides the support needed to allow other SPS recovery kits to operate properly on top of Linux logical volumes. To accomplish this support, the LVM Recovery Kit installs two new resource types: `lvmlv` and `lvmvg` which correspond to logical volumes and volume groups respectively. The `lvmlv` and `lvmvg` resources exist solely for internal use so that other SPS resources can operate.

As shown in Figure 1, each volume group has one or more logical volumes that depend on it. Conversely, each logical volume must have a volume group on which it depends. A typical SPS hierarchy containing these two LVM resources looks much like the relationships shown in Figure 1. Refer to Figure 2 in the SPS LVM Hierarchy Creation and Administration section for an example of an actual SPS hierarchy.

The LVM Recovery Kit uses the commands provided by the `lvm` package to manage the volume group and logical volume resources in an SPS hierarchy. Volume groups and logical volumes are configured (or activated) when a hierarchy is being brought in service during a failover or switchover operation and are unconfigured when a hierarchy is being taken out of service.

LVM Recovery Kit Notes and Restrictions

The following notes and restrictions apply to this version of the LVM Recovery Kit.

Support for Raw I/O and Entire Disks

While Figure 1 shows logical volumes residing below various file systems and volume groups on top of disk partitions, it is important to note that the LVM Recovery Kit can support raw access to logical volumes when used in conjunction with the SPS Raw I/O Recovery Kit and can manage volume groups that are composed of one or more entire disks (e.g. */dev/sdc*) rather than disk partitions (e.g. */dev/sdc1*).

Also see the section Using LVM with DataKeeper for a further option in the use of LVM.

Volume Group Activation

In the current LVM implementations, when a volume group is activated, all logical volumes associated with that volume group are also activated automatically. For SPS, this means that there will be times when a logical volume is active despite the fact that its associated resource instance is still marked as being Out-of-Service (OSU). In a typical failover or switchover operation, SPS will attempt to bring the logical volumes in service immediately after the volume groups anyway, and the resulting calls to the restore script will return immediately with a success indication. This unneeded attempt to bring the logical volumes in service has no usability impact.

Chapter 4: SPS LVM Hierarchy Creation and Administration

SPS LVM hierarchies are created automatically during the hierarchy creation process for resources that sit on top of logical volumes. The creation and extension of hierarchies containing the LVM resource types will always be driven by the create and extend processes of a higher-level resource type, likewise the delete and unextend.

The figure below is a LifeKeeper GUI screen shot showing a complete hierarchy containing LVM resources. Note that the resources in the hierarchy are displayed by their SPS IDs for clarity rather than the default display by tags.
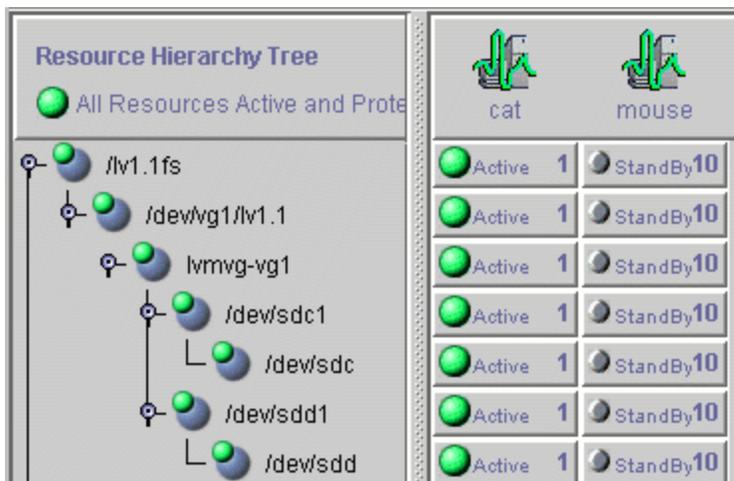

Figure 2: SPS Hierarchy Containing LVM Resources

The hierarchy pictured in Figure 2 is a file system hierarchy created by selecting the File System Recovery Kit under the **Edit** > **Server** > **Create Resource Hierarchy** menu selection. It consists of a file system resource, /lv1.1fs, mounted on an LVM logical volume, */dev/vg1/lv1.1*. That logical volume is a part of the vg1 volume group represented with the SPS ID lvmvg-vg1. The volume group vg1 is composed of two physical disk partitions, */dev/sdc1* and */dev/sdd1*. The hierarchy also includes the underlying disk devices, */dev/sdc* and */dev/sdd*, below each of the disk partitions.

Hierarchy Creation Procedure

To create a hierarchy in which a file system or higher-level application uses an LVM logical volume, the following high-level procedure should be followed.

1. Determine the desired configuration of your LVM volume groups and logical volumes. In doing this, keep in mind the following points:

   - All of the disk resources associated with a given volume group must move together from one server to another in the SPS cluster.

   - All of the logical volumes associated with a given volume group (and any file systems or applications which use them) must move together from one server to another in the SPS cluster.

   - Please disable lvmetad (it is enabled on RHEL 7 and SLES 12 by default). For a setting procedure, please refer to the documentation of operating systems.

2. On the system which is to be the primary server for your application, create and activate the desired volume groups and logical volumes using the tools provided by the LVM package and described in the LVM *HowTo* document referenced in the Documentation and References topic.

   If you are using shared storage, you must ensure that all physical volumes assigned to a volume group are properly shared between the machines in the SPS cluster on which you intend to run the protected application. If you intend to use LVM with DataKeeper, see the Using LVM with DataKeeper topic.

3. Create file systems on each of the logical volumes. If instead you intend to use raw I/O, bind a raw device to each of the logical volume devices.

4. Configure the protected application on the file systems following the configuration instructions in the administration guide for the SPS recovery kit associated with the application.

   Create and extend the application hierarchy following the instructions in the appropriate application recovery kit administration guide.

⚠️ **IMPORTANT**: Perform manual in-service operations to temporarily move the application hierarchy to each of the cluster nodes to which the hierarchy has been extended. This step must be done once prior to any node failover operations in order for the LVM subsystem on each cluster node to know about the configuration of the new volume groups and logical volumes. After you have performed these manual switchovers, move the application hierarchy back to the desired primary cluster node.

Using LVM with DataKeeper

SPS for Linux currently supports both the use of DataKeeper "above" LVM and LVM "above" DataKeeper. In a standard DataKeeper configuration, using DataKeeper above LVM is supported and does not require the SPS LVM Recovery Kit. DataKeeper is the only recovery kit necessary. However, using the LVM above DataKeeper configuration, the LVM Recovery Kit is required.

SIOS recommends using DataKeeper above LVM; however, if the LVM above DataKeeper configuration is being used, a two-phase hierarchy creation process must be used. The DataKeeper devices (i.e. hierarchies) must be configured using the DataKeeper "Data Replication Resource" option prior to the creation of the LVM volume groups and logical volumes on the primary server. Once the desired volume groups and logical volumes have been created, the remainder of the hierarchy is created according to the configuration instructions for the recovery kit associated with the application to be protected. The resulting hierarchy will

look something like the one shown in Figure 3 below. **Note**: For data consistency reasons, in an LVM over DataKeeper configuration, there must either be only one DataKeeper mirror or multiple *synchronous* mirrors.
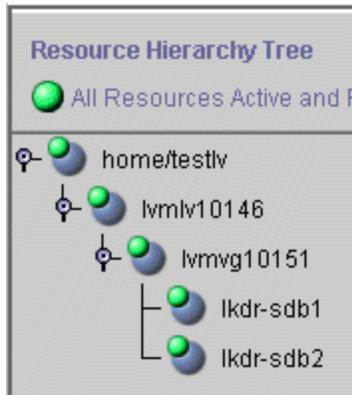

Figure 3: Hierarchy with LVM above DataKeeper

Volume Group Reconfiguration

One of the primary benefits of using a logical volume manager is the ability to dynamically resize logical volumes as storage requirements change. Because this may involve adding or deleting physical partitions or disks from an LVM volume group definition, the LVM Recovery Kit includes a mechanism for modifying an existing resource hierarchy to reflect such a change.

All volume group, logical volume and file system reconfiguration should be performed outside of SPS prior to modifying the SPS hierarchy to reflect the changes. Refer to the LVM *HowTo* document referenced in the Documentation and References section for information about how this is done. If any of the steps require you to **unmount** or **unconfigure** a resource that is being protected by SPS, be sure to use the LifeKeeper GUI to do so, using the **Out of Service** operation.

> ⚠️ **IMPORTANT**: The new device MUST be seen by both systems (shared) before SPS will allow the reconfiguration to take place.

To update an SPS hierarchy following these changes, first access the **Resource Properties** dialog for the modified volume group, either by right-clicking on the active volume group resource and selecting **Properties** or by using the **Edit** > **Resource** > **Properties** menu selection and selecting the appropriate volume group resource in the **Select Resource** field. The resulting **Resource Properties** dialog should look like the one pictured in Figure 4 below including the **Resource Configuration** button near the bottom.
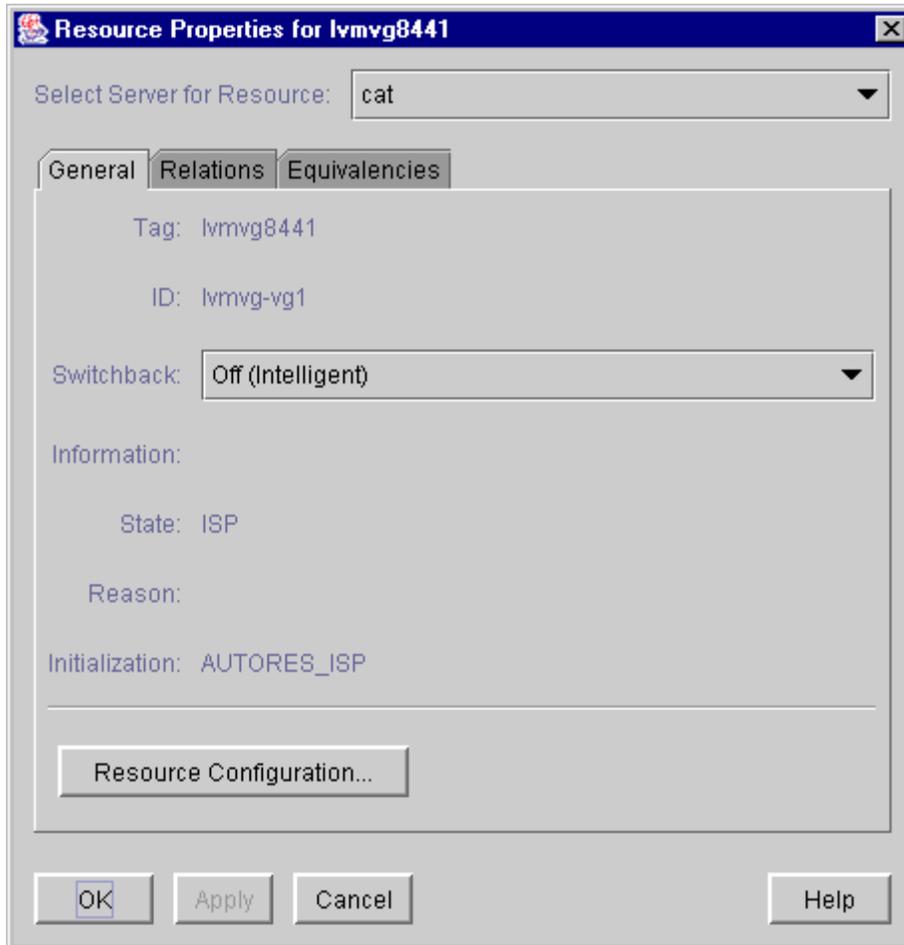
Figure 4: LVM Volume Group Resource Properties Dialog

Clicking the R**esource Configuration** button initiates the mechanism for reconfiguring your hierarchy to reflect any modifications to the volume group resource. After a brief pause, an information box will display the volume group modifications that SPS has detected. Figure 5 below shows an example in which a single disk partition has been added to a volume group.
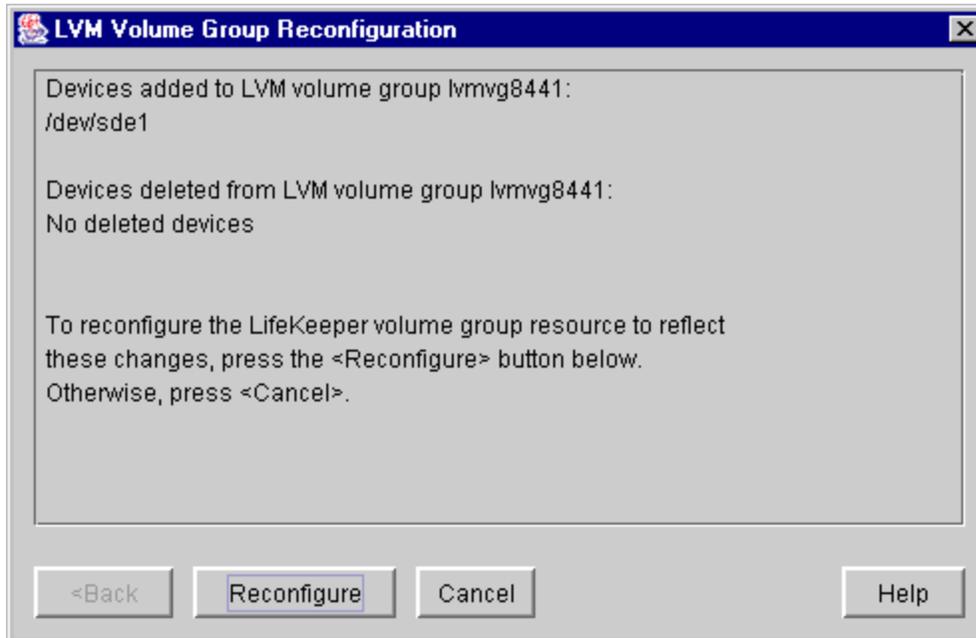
Figure 5: LVM Volume Group Reconfiguration for Added Device

As stated in the information box, to reconfigure the SPS volume group to reflect the changes that have been detected, simply click the **Reconfigure** button. If you do not wish to proceed with the SPS hierarchy modification, click **Cancel**.

After clicking the **Reconfigure** button, an information box will appear showing the progress of the reconfiguration procedure as shown in **Figure 6** below. When the process has been completed successfully, the **Done** button will become enabled. Clicking **Done** will close the information box and return you to the display of the **Resource Properties** dialog.
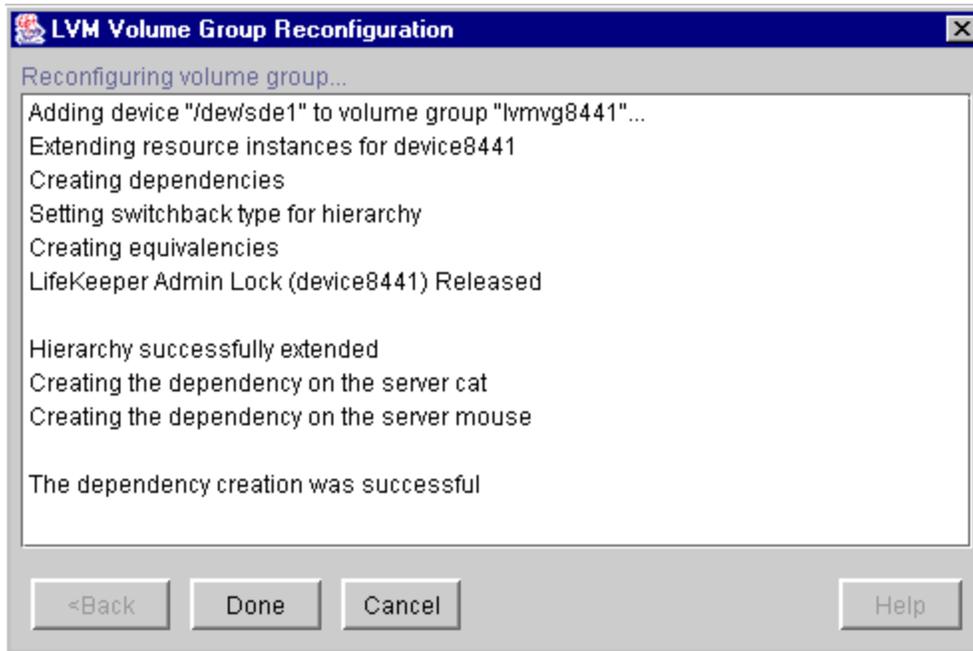
Figure 6: LVM Volume Group Reconfiguration for Added Device

The following two figures show examples of the information boxes that would be displayed during the reconfiguration process when a device partition has been removed from a volume group.
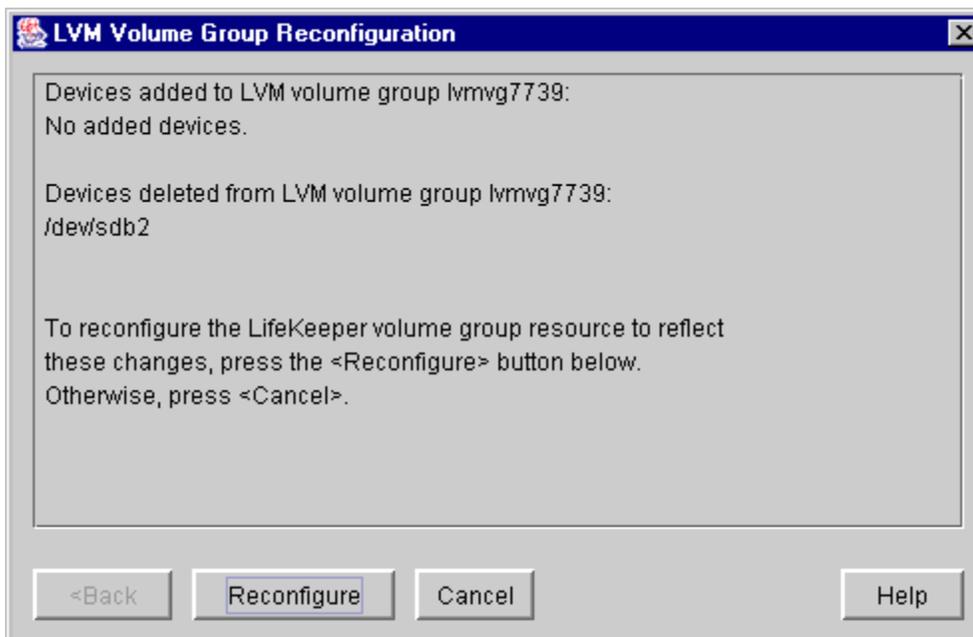

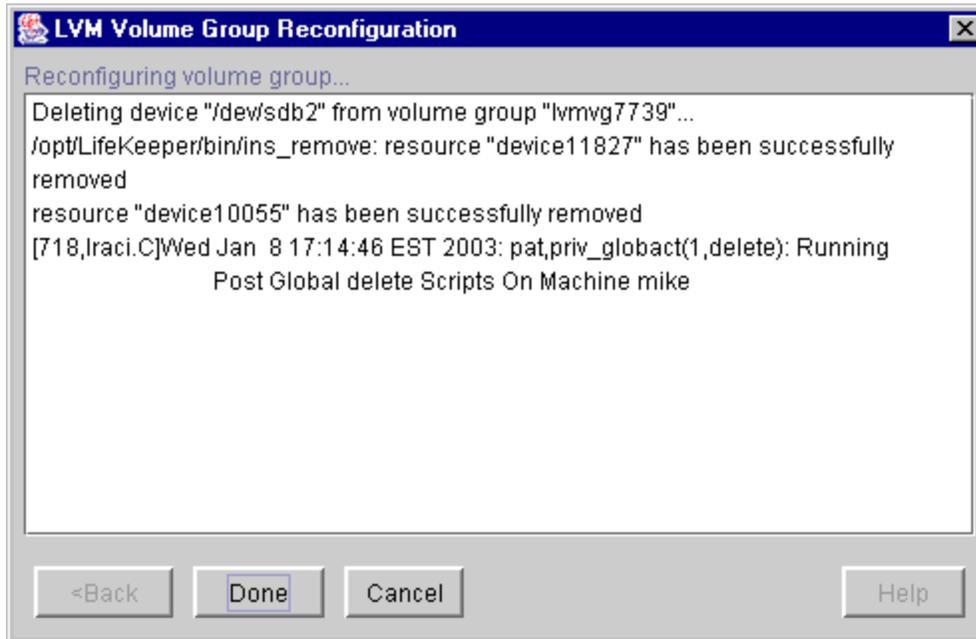**Figure 7: LVM Volume Group Reconfiguration for Deleted Device**

Figure 8: LVM Volume Group Reconfiguration for Deleted Device

Chapter 5: Troubleshooting

Error Messages

This section provides a list of messages that you may encounter with the use of the SPS LVM Recovery Kit. Where appropriate, it provides an additional explanation of the cause of an error and necessary action to resolve the error condition.

Because the LVM Recovery Kit relies on other SPS components to drive the creation and extension of hierarchies, messages from these other components are also possible. In these cases, please refer to the Message Catalog (located on our Technical Documentation site under "Search for an Error Code") which provides a listing of all error codes, including operational, administrative and GUI, that may be encountered while using SIOS Protection Suite for Linux and, where appropriate, provides additional explanation of the cause of the error code and necessary action to resolve the issue. This full listing may be searched for any error code received or you may go directly to one of the individual Message Catalogs for the appropriate SPS component.

LVM Recovery Kit Error Messages

Error Number	Error Message
110000	<LVM resource type> resource type is not installed on <SPS server name>. Action: Install the LVM Recovery Kit on the identified system.
110001	This script must be executed on <SPS server name>.
110002	Failed to create <device name> hierarchy.
110003	Failed to create dependency <resource tag>-<resource tag> on machine <SPS server name>.
110004	LifeKeeper internal ID <resource ID> already in use.
110005	<LVM resource type> constructor requires a valid argument.
110006	Usage: adddelpv <VG tag> [addlist|dellist]
110007	WARNING: Failure in updating list of LifeKeeper-controlled volume groups (`/etc/lkvgs`).
110008	WARNING: The device hierarchy for <device name>, with tag <device resource tag>, cannot be extended automatically. Action: If the device hierarchy is not already extended, extend it using the LifeKeeper GUI. Then create a dependency from the volume group resource to the device hierarchy.

Error Number	Error Message
110009	Failed to create a dependency between volume group resource <volume group tag> and device resource <device tag>. Action: Create the dependency using the LifeKeeper GUI.
110010	Failed to make the LVM logical volume <Logical Volume Path> active with error code <error code>.
110011	Failed to `vgscan` the LVM volume group <Volume Group Name> with error code <error code>.
110012	Failed to `vgimport` the LVM volume group <Volume Group Name> with error code <error code>.
110013	Failed to make the LVM volume group <Volume Group Name> active with error code <error code>.