White Paper

NetVault Backup Greatly Reduces the Cost of Backup Using All-Flash Arrays with the Latest LTO Ultrium Technology

–Unlimited Backup Capacity and Number of Generations–

Adoption of all-flash arrays is increasing steadily, but from a cost-effectiveness point of view, the backup capacity and the number of generations must be taken into consideration.
NetVault Backup, which is widely used in Linux environments, allows backups using the latest LTO tape technology while lowering costs.

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Preface

In recent years, all-flash arrays have become mainstream, but the price of flash memory remains high. For example, even though flash memory provides high speed performance, that benefit is offset by the cost of increasing the number of backup generations.

A solution to this problem is to combine the all-flash array with LTO tape technology.
This method consists of changing the storage destination of the backup data in the all-flash array from the backup dedicated flash storage to LTO tape cartridges.
Because LTO tape cartridges are cheaper than flash memory, cost concerns are eliminated even if a large number of backup generations are required.

A data protection product (backup software) is required to store backup data to LTO tape cartridges.
This document describes the characteristics of the procedure for backing up the data from the ETERNUS AF series and the ETERNUS DX series to the LTO tape unit using NetVault Backup (data protection product) with the ETERNUS LT series and ETERNUS SF AdvancedCopy Manager. In addition, the system configuration for backup operations, the environment configuration procedure, and the backup operation procedure are also provided.
The verification results described in this document are current as of September 2018.

The product lineup and product information stated in this document are current as of November 2019.

■Target Audience

This document targets the following audience:

- Those who want to install an all-flash array while minimizing the Total Cost of Ownership (TCO)
- Those who want to learn more about NetVault Backup to help select a data protection product for their all-flash arrays
- Those who want an overview of the tape backup tasks using NetVault Backup

■Applicable Series

This document covers the following storage systems:

- FUJITSU Storage ETERNUS AF150 S3, AF250 S3/S2, and AF650 S3/S2
- FUJITSU Storage ETERNUS DX100 S5/S4, DX200 S5/S4, DX500 S5/S4, DX600 S5/S4, DX900 S5, and DX8900 S4
- FUJITSU Storage ETERNUS LT series

■Terminology

The following terms are used in this document:

- Storage system ..... A storage system consisting of flash storage
- Tape unit ..... A device that reads data from and writes to magnetic tape (Includes tape libraries that have a "robot mechanism" for moving tape cartridges)
- Advanced Copy function ..... A function of the FUJITSU Storage ETERNUS AF series and ETERNUS DX series that transfers data in the storage system at high-speed without using the CPU of the server to copy data

■Naming Conventions

The following abbreviations are used in this document:

- FUJITSU Storage ETERNUS AF series All-Flash Arrays ..... ETERNUS AF series
- FUJITSU Storage ETERNUS DX series Hybrid Storage Systems ..... ETERNUS DX series
- FUJITSU Storage ETERNUS LT series ..... ETERNUS LT series
- ETERNUS SF AdvancedCopy Manager ..... ACM

1. Back-up Challenges and Solutions for All-Flash Arrays

1.1. Flash to Flash Backup Issue

For data backups within the all-flash array, increasing the number of generations in the backup destination raises cost concerns. Using the all-flash array for backups boosts the access speed to backup destinations, but the cost increases proportionally with the number of backup generations.
Because the business data can be transferred at high speed from flash storage to the backup dedicated flash storage, business downtime is not an issue since disruptions due to securing backup points are negligible.

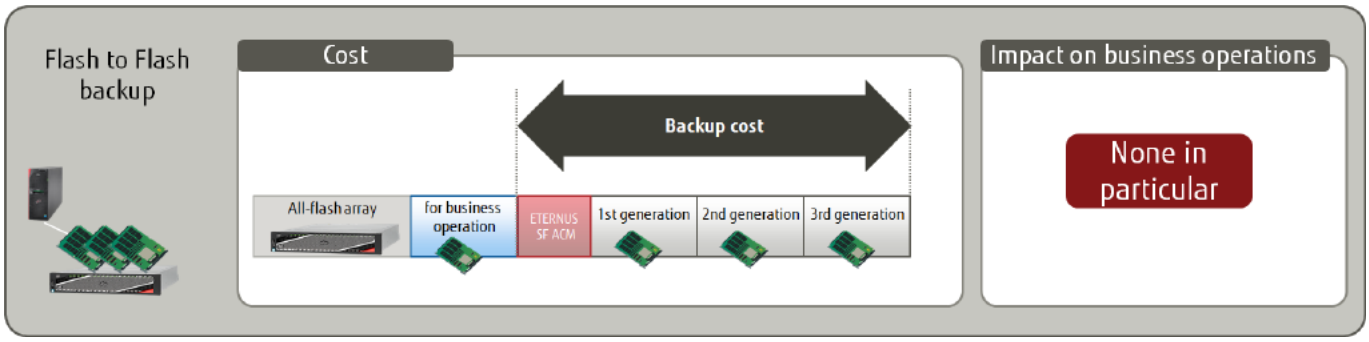


Figure 1-1 Flash to Flash Backup

1.2. Flash to Tape Backup Issue

LTO tape cartridges can be stored to an off-site location after removing them from the tape library. By storing to an off-site location, the limit on the number of generations is eliminated. For backups directly from the all-flash array to an LTO tape cartridge, the cost benefit remains even if the number of generations increases because low-cost LTO tape cartridges are used. The combined cost of tape units, data protection products, and LTO tape cartridges is considerably less than purchasing additional flash storage required for additional backup generations.
However, the benefits of using LTO tape cartridges are somewhat offset by business downtime to restrict access to the business data during a backup from the all-flash array to the LTO tape unit.

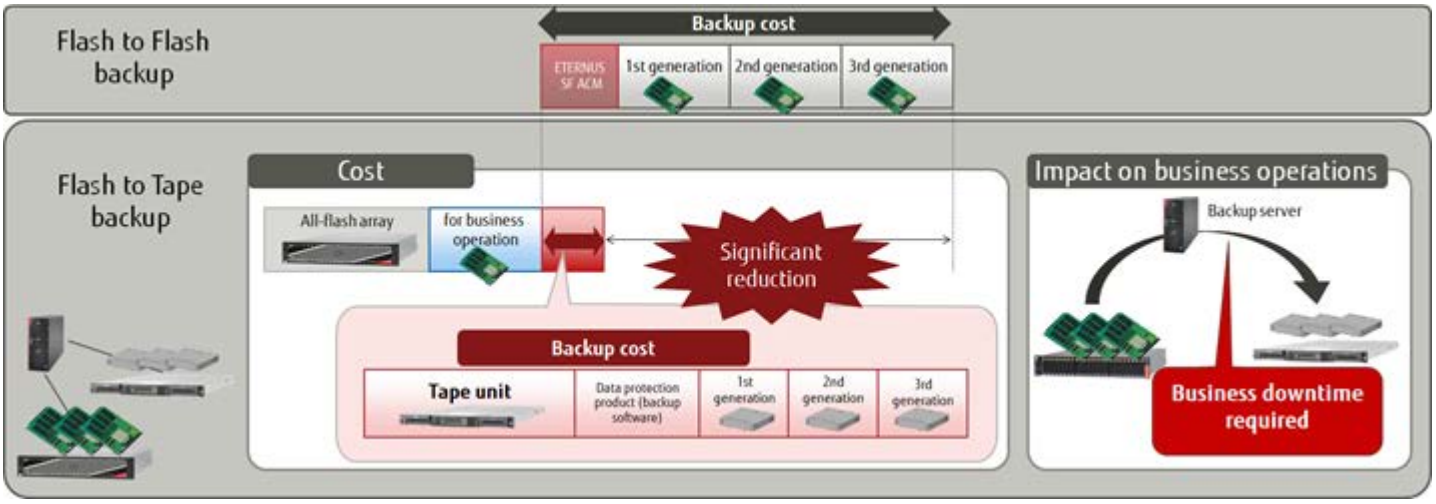


Figure 1-2 Comparison of Flash to Flash Backup and Flash to Tape Backup

1.3. Flash to Flash to Tape Backup Solution

This method can solve the issues inherent to both flash to flash backups and flash to tape backups by backing up the business data from flash storage to the backup dedicated flash storage and then backing up the data to LTO tape cartridges.
Details of the flash to flash to tape solution are as follows.

Storing backup generations to LTO tape cartridges resolves the issue of flash to flash backups where all backup generations are stored in the all-flash array. With the cost per storage volume of the LTO tape cartridge being less than flash storage by a factor of two, LTO tape cartridges are more economical than flash storage. For LTO tape cartridges, there is no limit for the number of generations in the backup destination and the cost is minimal even if the number of generations is increased.

Business downtime, which is associated with flash to tape backups (backups directly from the all-flash array to an LTO tape cartridge), is unnecessary since the business data is backed up quickly to the backup dedicated flash storage using the all-flash array function. Furthermore,

other than when a backup is running, a restore can be completed instantly because the most recent backup is stored in the backup dedicated flash storage.
If no backup data is stored in the backup dedicated flash storage, the backup data must be restored from the LTO tape unit, which requires extra time. If a long restore time is not a problem, the cost advantages of flash to flash to tape backups outweigh the disadvantages.

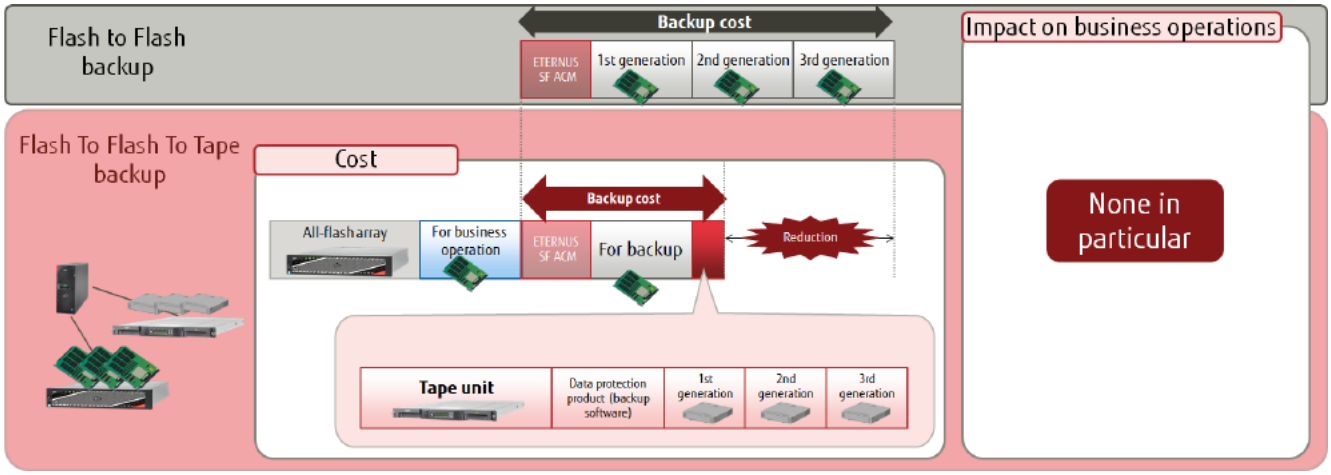


Figure 1-3 Comparison of Flash to Flash Backup and Flash to Flash to Tape Backup

1.3.1. Latest Trend in LTO Tape Formats

The latest generation of LTO formats is the 8th generation (LTO-8).
The merits of adopting LTO-8 are explained below based on comparisons with previous generations in terms of cost and performance.

LTO-8 can store up to 30 TB (compressed) per cartridge. Backup and restore times have been greatly reduced as well as the cost compared to previous generations.
As a cost comparison, a backup capacity of 60 TB can be realized with just two LTO-8 cartridges compared with ten LTO-6 cartridges, a reduction of approximately 80%. In addition, although a 20-cartridge tape unit is required for LTO-6, an 8-cartridge entry model can be selected for LTO-8 and LTO-7. LTO-8 does not require higher end tape units or a large number of cartridges which adds to the cost savings.

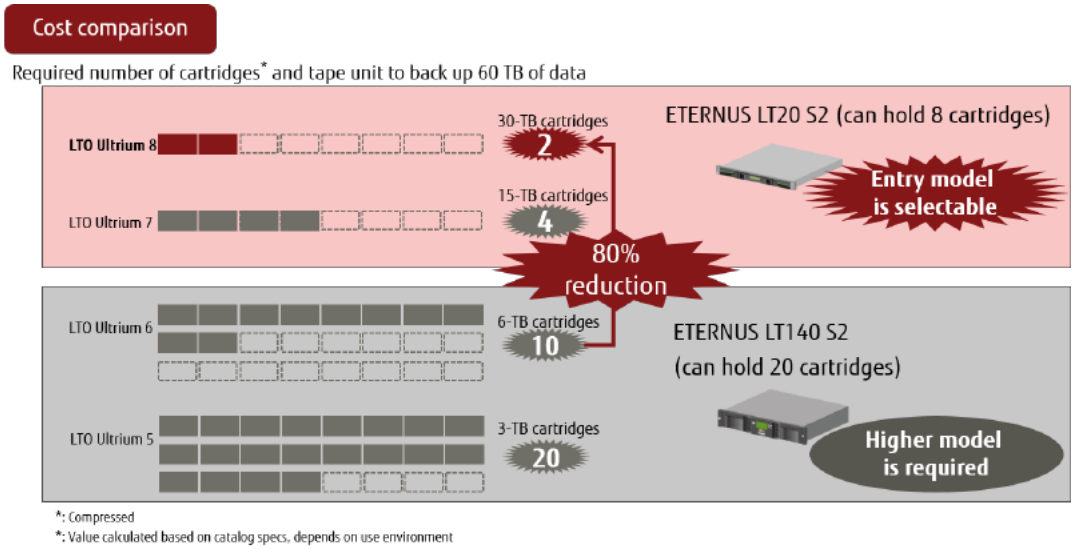


Figure 1-4 Cost Comparison of LTO-8 with Previous Generations

On the performance side, although the calculations are based on the catalog specifications, the transfer performance of LTO-8 is nearly double compared with LTO-6, so backups can be completed in almost half the time.

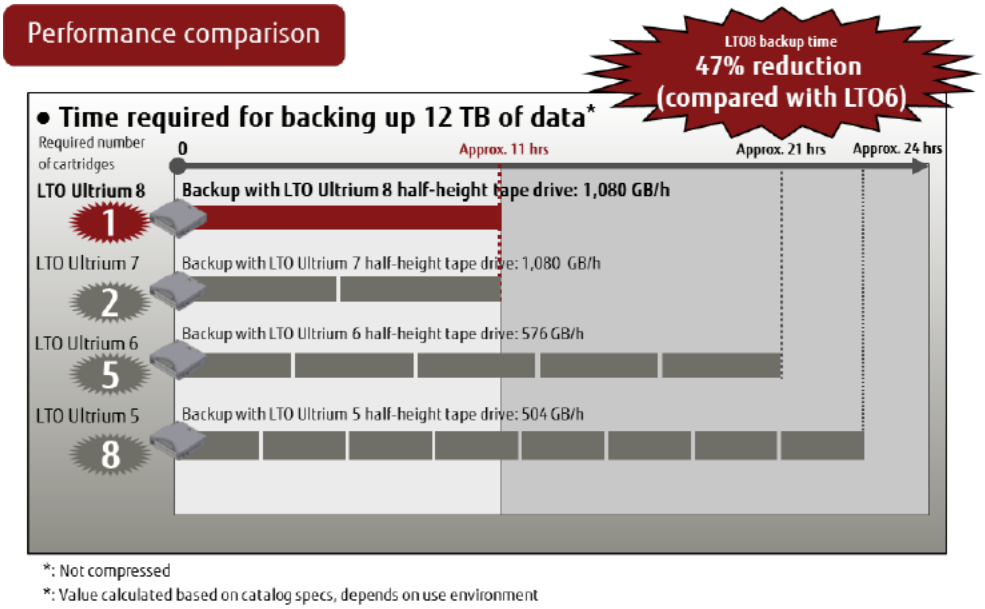


Figure 1-5 Performance Comparison of LTO-8 and Previous Generations

Some LTO tape cartridges are read-only or incompatible with certain generations of LTO Ultrium tape drives.
Selecting cartridges with the latest LTO Ultrium generation is recommended because older generations may not be supported by the tape unit.

Furthermore, since LTO units are magnetic tape units, the dust generated from the magnetic tape or fine dirt entering the device will inevitably adhere to the magnetic head of the tape drive. This may cause errors and failure. To ensure stable operation, the drive must be cleaned periodically.
For this reason, a cleaning cartridge is provided to clean the magnetic head of the tape drive and can be used up to 50 times.
Instructions on how to use the cleaning cartridge are provided in the appendix.

2. NetVault Backup Overview

NetVault Backup is a data protection product that supports various platforms and is widely used on Linux platforms. By using a backup server installed with NetVault Backup Server, backups and restores can be managed centrally regardless of the size of the environment: small-scale with one or several devices, or large-scale with many devices.
Because the backup destination can be hard disks, tape, or the cloud, the most appropriate storage location can be selected based on your environment.

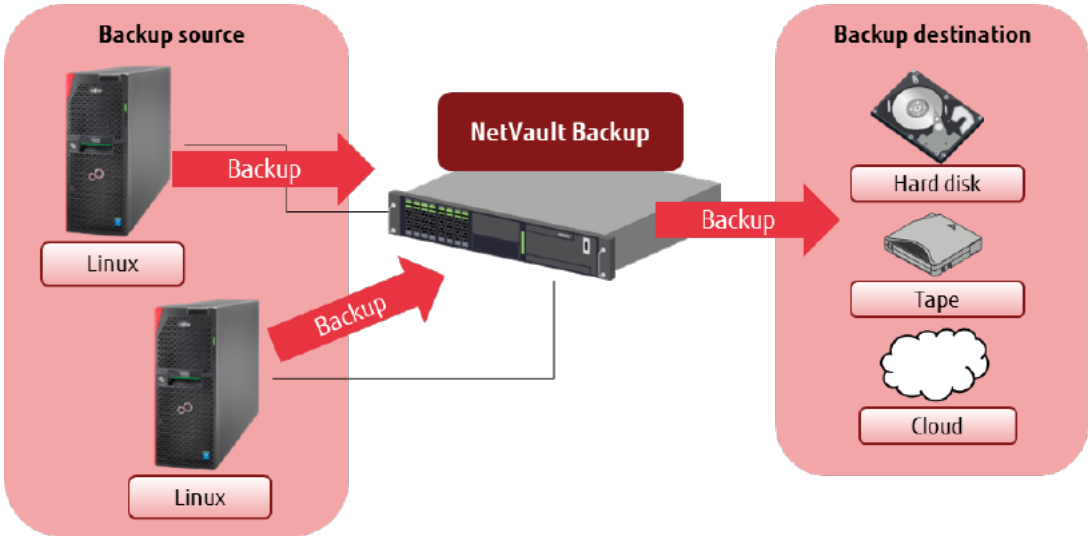


Figure 2-1 NetVault Backup Diagram

Because NetVault Backup operations are performed using the user-friendly NetVault Backup Server WebUI, users can easily manage media such as tape cartridges and hardware devices, configure backup and restore jobs, execute jobs, and check job statuses.
The following shows an example of the NetVault Backup WebUI home screen.

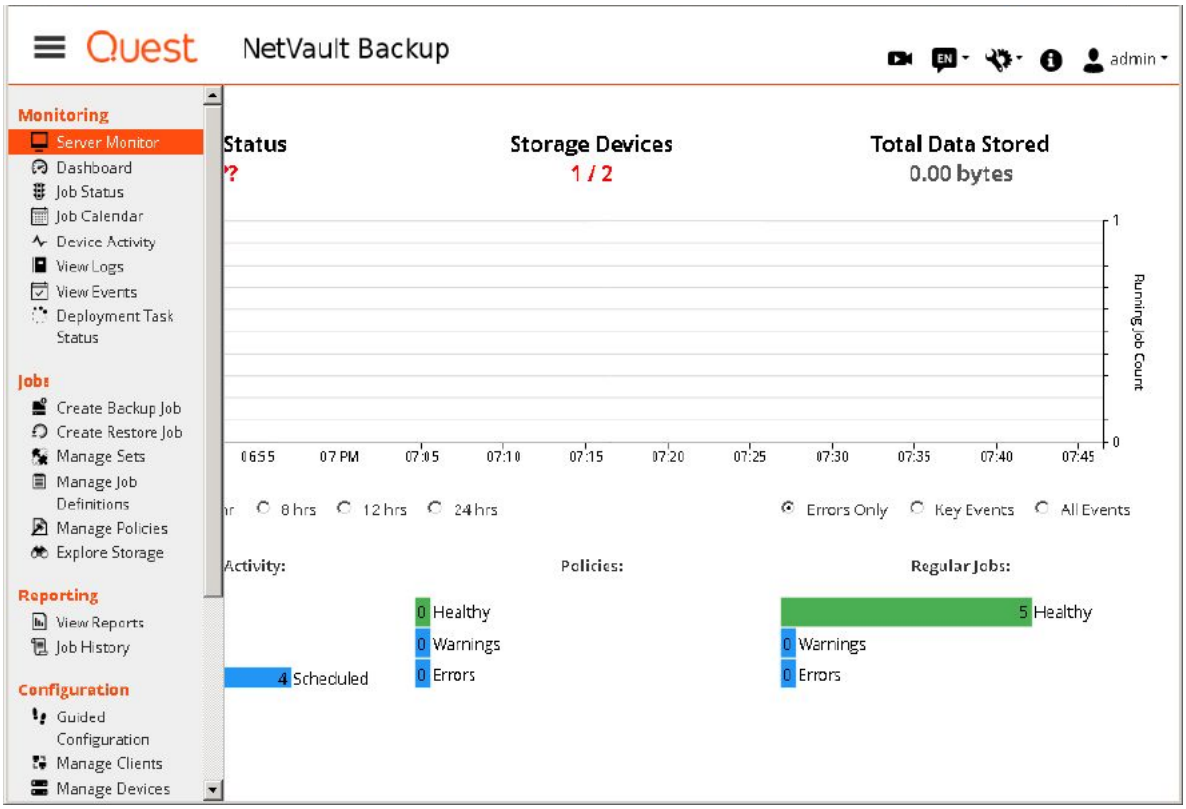


Figure 2-2 WebUI Home Screen of NetVault Backup Server

3. Backup/Restore Verification Using ACM and NetVault Backup

This section describes the backup and restore verification of an all-flash array and LTO tape combination.

3.1. Verification Details

A verification is performed to confirm that the three-generation backup of the production volume on the all-flash array is stored to the LTO tape unit and that the restore is completed successfully.

The production volume in the all-flash array is backed up to the backup volume in the all-flash array with the Advanced Copy function QuickOPC and is then backed up to the tape library (LTO tape unit) with NetVault Backup for generation management.
The data of the production volume is stored in the LTO tape cartridge when QuickOPC is executed.

In this verification, two backup types to the LTO tape unit are verified: Full backup and incremental backup.
The restore operation consists of restoring data from the LTO tape unit to the backup volume of the all-flash array and then restoring the data of the backup volume to the production volume with OPC of the Advanced Copy function.

In the verification environment, backups and restores are performed with ACM.
ACM is a storage management software that allows high-speed backups/restores and replication operations with the Advanced Copy function.
Configure the ACM agent in the business server and the ACM Manager/agent in the backup server, and use them for backup and restore operations.

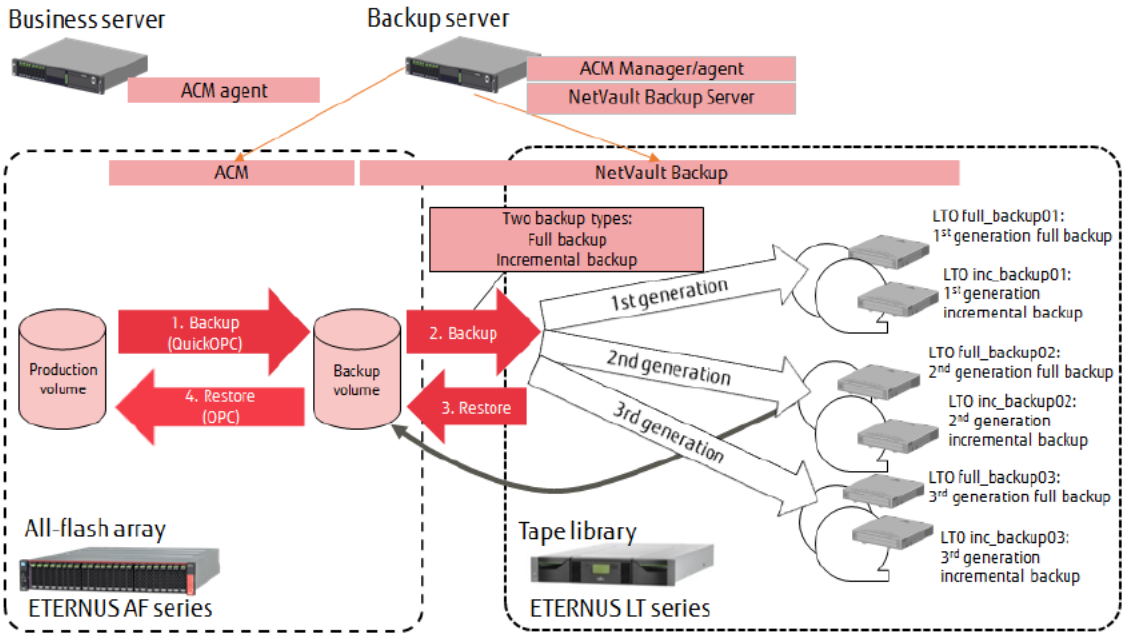


Figure 3-1 Verification Diagram

Use the following procedure to perform backups with ACM and NetVault Backup.
1. Execute QuickOPC from ACM Manager to back up data from the production volume to the backup volume.
2. From NetVault Backup Server, perform a full or incremental backup of the data from the backup volume to the LTO tape cartridges.

The data of the production volume backed up with QuickOPC is currently stored in the LTO tape cartridges.

Use the following procedure to restore data from the LTO tape cartridges to the production volume.
3. Perform a restore from NetVault Backup Server to restore data from the LTO tape cartridges to the backup volume.
4. Execute OPC from ACM Manager to restore data from the backup volume to the production volume.

Full backup verification

Verification of a full backup consists of backing up the production volume to the backup volume and then backing up the backup volume to the LTO tape cartridges with a backup job of NetVault Backup.
To back up the production volume, execute QuickOPC with **swsrpmake** (replication creation command) of ACM.
NetVault Backup automatically starts the backup job of each generation at a fixed interval.

The full backup verification method is shown below.

Backup Generation	Backup Method		LTO	Remark
	Production volume → Backup volume	Backup volume → LTO tape cartridge		
1st generation	Execute QuickOPC with **swsrpmake**	Start backup job #1 of NetVault Backup (full backup)	full_backup01	Backup jobs of NetVault Backup start automatically at a fixed interval.
2nd generation	Execute QuickOPC with **swsrpmake**	Start backup job #2 of NetVault Backup (full backup)	full_backup02	
3rd generation	Execute QuickOPC with **swsrpmake**	Start backup job #3 of NetVault Backup (full backup)	full_backup03	

Table 3-1 Full Backup Verification Method

Incremental backup verification

Verification of an incremental backup consists of backing up the production volume to the backup volume and then backing up the backup volume to the LTO tape unit, but only the differential data from the last backup, with a backup job of NetVault Backup.
To back up the production volume, execute QuickOPC with **swsrpmake** of ACM.
NetVault Backup automatically starts the backup job of each generation at a fixed interval.

The incremental backup verification method is shown below.

Backup Generation	Backup Method		LTO	Remark
	Production volume → Backup volume	Backup volume → LTO tape cartridge		
1st generation	Execute QuickOPC with **swsrpmake**	Start backup job #1 of NetVault Backup (incremental backup)	inc_backup01	Backup jobs of NetVault Backup start automatically at a fixed interval.
2nd generation	Execute QuickOPC with **swsrpmake**	Start backup job #2 of NetVault Backup (incremental backup)	inc_backup02	
3rd generation	Execute QuickOPC with **swsrpmake**	Start backup job #3 of NetVault Backup (incremental backup)	inc_backup03	

Table 3-2 Incremental Backup Verification Method

Restore verification

Verification of a restore consists of restoring data from the LTO tape cartridge, which is the full backup data of the second generation, to the backup volume with NetVault Backup.
To restore data from the backup volume to the production volume, execute OPC with **swsrpmake** of ACM.

The restore verification method is shown below.

Restore Generation	LTO	Restore Method		Remark
		LTO tape unit → Backup volume	Backup volume → Production volume	
Full backup of the 2nd generation	full_backup02	Start the restore job by specifying the target NetVault Backup full backup saveset	Execute OPC with **swsrpmake**	NetVault Backup restore job starts immediately.

Table 3-3 Restore Verification Method

3.2. System Configuration

The system configuration of the verification environment is described below.
Connect the business server, backup server, all-flash array, and tape library via the SAN.
Install ACM agent on the business server.
On the backup server, install ACM Manager/agent and NetVault Backup Server.
Use Red Hat Enterprise Linux 7.4 for the OS on both the business server and the backup server.

The system configuration of this verification environment and the list of devices used are shown below.

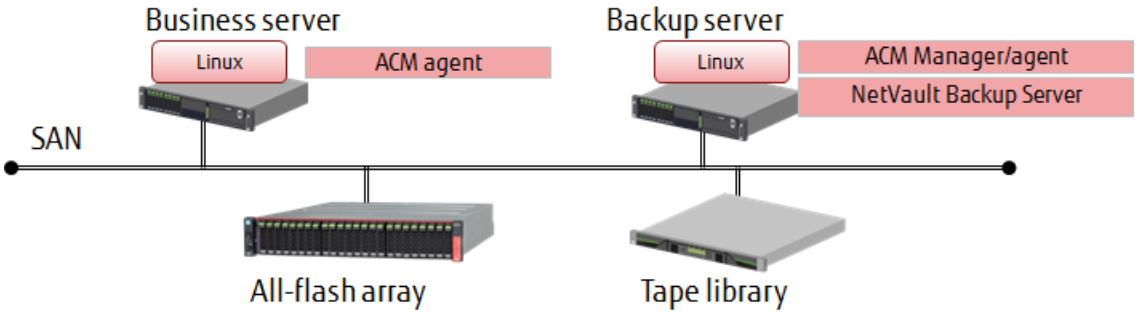


Figure 3-2 System Configuration Diagram

Device	Model	Remark
Business server	PRIMERGY RX2540 M1	Fibre Channel interface × 2
Backup server	PRIMERGY RX2540 M1	Fibre Channel interface × 2
All-flash array	ETERNUS AF250 S2	Flash storage × 4 (RAID 5) Fibre Channel interface × 4
Tape library	ETERNUS LT20 S2	Tape drive × 1, slot × 8 Fibre Channel interface × 1

Table 3-4 Device List

The management LAN and operation terminals are omitted from the diagram. The business server, backup server, all-flash array, and tape library must be connected via the same management LAN.
A Fibre Channel switch connected to the SAN is also required.

Software and licenses
- Red Hat Enterprise Linux 7.4 × 2 licenses (for the business server and the backup server)
- NetVault Backup 12 SERVER STARTER EDITION × 1 license
- ETERNUS SF Storage Cruiser Standard Edition 16 Tier1 × 1 license
- ETERNUS SF AdvancedCopy Manager Standard Edition 16 Tier1 × 1 license

3.3. System Construction

An overview of the system construction is described below.

SAN connection
Connect each device to the Fibre Channel switch to enable communication between the business server and the all-flash array, between the backup server and the all-flash array, and between the backup server and the tape library. In an actual environment, zoning is set in the Fibre Channel switch according to security requirements.

All-flash array
For the all-flash array, configure a RAID with flash memory and assign the production volume and backup volume used by the business server to the RAID. Assign the same size for the production volume and the backup volume.

Format the production volume from the business server.
The backup volume does not need to be formatted before the backup is performed. However, the volume must be mountable from the backup server.
Before starting the verification, a mount point must be assigned for the backup volume in the backup server.

To perform a copy using the functions of ETERNUS with ACM, create a software role account and register the following licenses in the ETERNUS using ETERNUS Web GUI.
- ETERNUS SF Storage Cruiser Standard Edition license
- ETERNUS SF AdvancedCopy Manager Standard Edition license

Tape library
In the tape library, insert six tape cartridges (LTO) and a cleaning tape cartridge.

ACM installation and initial settings
On the backup server, perform a standard installation of ACM Manager and ACM agent.
Perform a standard installation of ACM agent on the business server.
On the Linux backup server, create a user account for ETERNUS SF Storage Cruiser.

NetVault Backup installation and initial settings
On the backup server, perform a standard installation of NetVault Backup Server.
No additional configuration is required for NetVault Backup other than the installation. NetVault Backup will automatically recognize the backup volume and tape library.

List of system setting values
The following table shows the main setting values for the verification environment.
The following values are used for backups/restores with ACM and NetVault Backup.

Item	Target	Setting Value	Remark
Device name	Business server	GYOM01	
	Backup server	MGR001	
Volume name	Production volume	/dev/sdb1	
	Backup volume	/dev/sdb1	Assign the mount point /home/bkdisk in the backup server

Table 3-5 List of System Setting Values

List of NetVault Backup media
The following table shows a list of media used in the NetVault Backup verification.

LTO Tape Cartridge	Label	Storage Slot	Remark
Full backup 1st generation	full_backup01	1	Labels can be set from the Manage Devices screen of NetVault Backup
Full backup 2nd generation	full_backup02	2	
Full backup 3rd generation	full_backup03	3	
Incremental backup 1st generation	inc_backup01	4	
Incremental backup 2nd generation	inc_backup02	5	
Incremental backup 3rd generation	inc_backup03	6	

Table 3-6 List of NetVault Backup Media

List of backup job setting values of NetVault Backup
The following tables show the backup job setting values and the sets used for NetVault Backup verifications.

Item	Target Job	Setting Value					
		Job Name	Selections Set Name	Plugin Options Set Name	Schedule Set Name	Target Storage	Advanced Options
Backup job	Full backup 1st generation	full_backup	full_backup_data	full_backup_option	full_backup_schedule1	full_backup_target1	Default
	Full backup 2nd generation	full_backup2			full_backup_schedule2	full_backup_target2	
	Full backup 3rd generation	full_backup3			full_backup_schedule3	full_backup_target3	
	Incremental backup 1st generation	inc_backup1		inc_backup_option	inc_backup_schedule1	inc_backup_target1	
	Incremental backup 2nd generation	inc_backup2			inc_backup_schedule2	inc_backup_target2	
	Incremental backup 3rd generation	inc_backup3			inc_backup_schedule3	inc_backup_target3	

Table 3-7 Backup Job Setting Values of NetVault Backup

Type of Sets	Usage	Setting Value		Remark
		Set Name	Advanced Options	
Selections	Full and incremental backup	full_backup_data	Target directory: /home/bkdisk	
Plugin Options	Full backup	full_backup_option	Backup Method: Standard Backup Type: Full	
	Incremental backup	inc_backup_option	Backup Method: Standard Backup Type: Incremental	
Schedule	Full backup	full_backup_scheduln	Schedule Type: Repeating Schedule Options: Run at xx:xx (Any time, change start times between generations) Run every 6 Hours	n indicates the backup generation number
	Incremental backup	inc_backup_scheduln	Schedule Type: Repeating Schedule Options: Run at xx:xx (Any time, change start times between generations) Run every 6 Hours	n indicates the backup generation number
Target Storage	Full backup	full_backup_targetn	Device Selection: Using any device Media Options: Specific Media ID full_backupn Reuse Media (Never) Media Sharing: None	n indicates the backup generation number
	Incremental backup	inc_backup_targetn	Device Selection: Using any device Media Options: Specific Media ID inc_backupn Reuse Media (Never) Media Sharing: None	n indicates the backup generation number

Table 3-8 List of NetVault Backup Sets

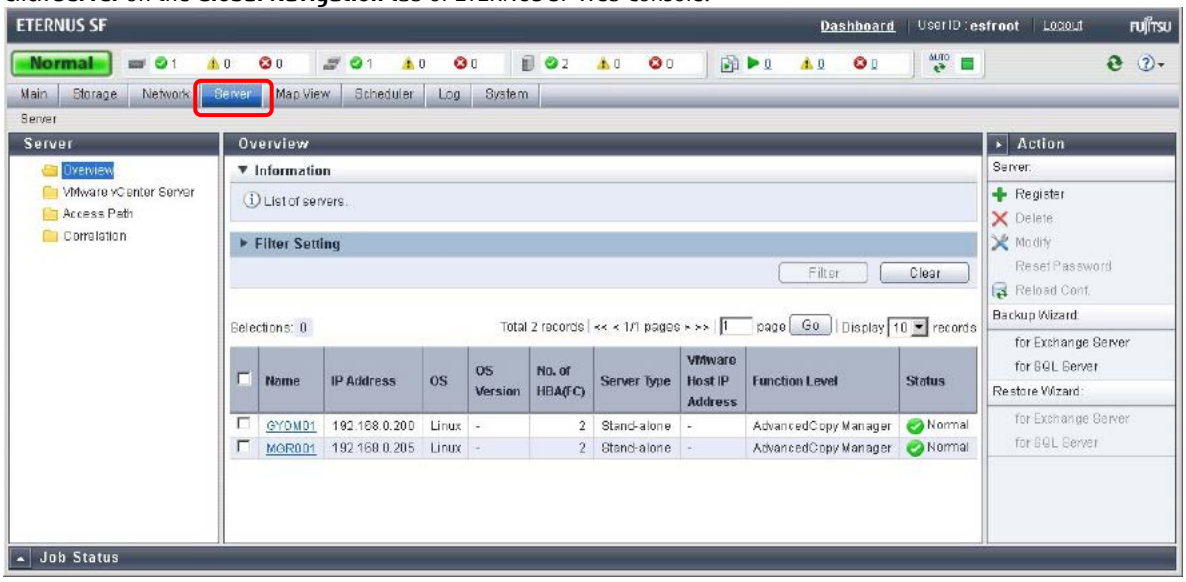
3.4. Verification Procedure

3.4.1. Backup Verification Procedure

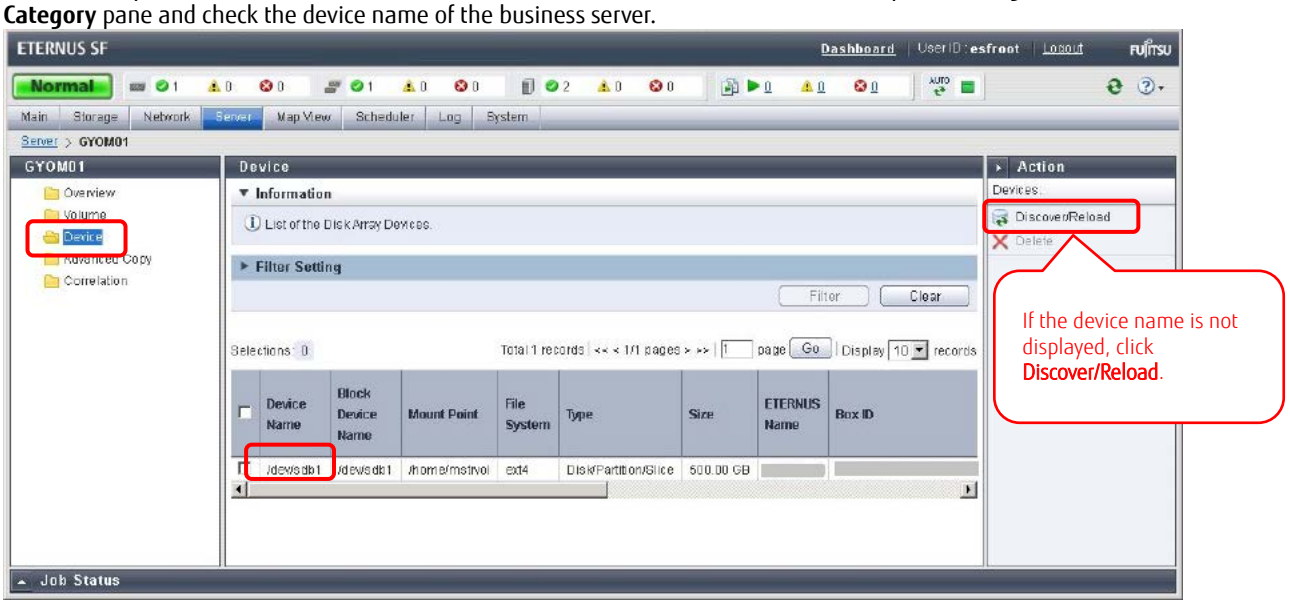
This section describes the backup verification procedure using ACM and NetVault Backup.

3.4.1.1. Configuration of ACM

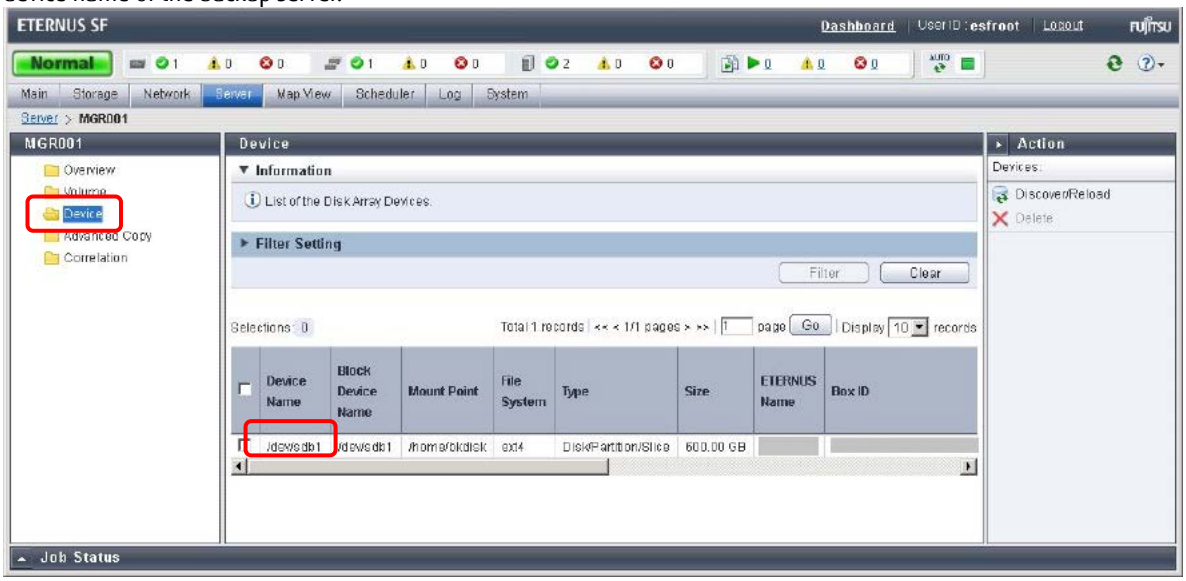
(1) Check the device name
On ETERNUS SF Web Console, confirm the device names of the business server (GYOM01) and backup server (MGR001).
Click **Server** on the **Global Navigation** tab of ETERNUS SF Web Console.



On the main pane of the Overview screen, click GYOM01 under the **Name** column of the operation target server, then click **Device** in the **Category** pane and check the device name of the business server.



On the main pane, click MGR001 under the **Name** column of the operation target server, then click **Device** in the **Category** pane and check the device name of the backup server.



(2) Set the source and destination volumes
Set the source and destination volumes to be used for backups.
Execute **swsrpsetvol** (replication volume information setting command) from the command prompt of the backup server, set the device name /dev/sdb1 as the source volume (business server) and the device name /dev/sdb1 as the destination volume (backup server). *2

```
# /opt/FJSVswsrp/bin/swsrpsetvol -n -o ORG -u /dev/sdb1@GYOM01 /dev/sdb1
swsrpsetvol completed
#
```

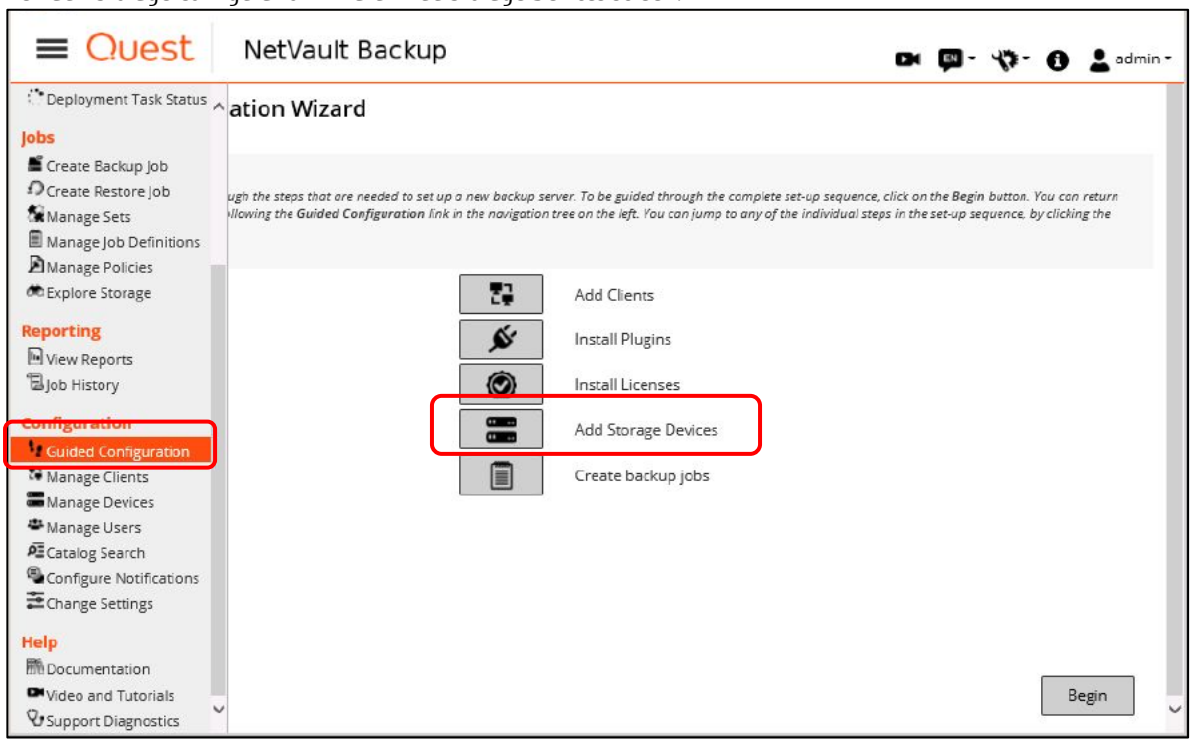
Execute **swsrpvolinfo** (replication volume information display command) to confirm the settings.

```
# /opt/FJSVswsrp/bin/swsrpvolinfo -h GYOM01
Server Original-Volume  Size        Replica-Volume   Size        Copy          Op-Server
GYOM01 /dev/sdb1@GYOM01  499.9 Gbyte /dev/sdb1@MGR001  599.9 Gbyte uni-direction original
#
```

*2: In this verification, **swsrpsetvol** is specified with the -u option to prevent a reverse volume copy.

3.4.1.2. Adding a Storage Device to NetVault Backup

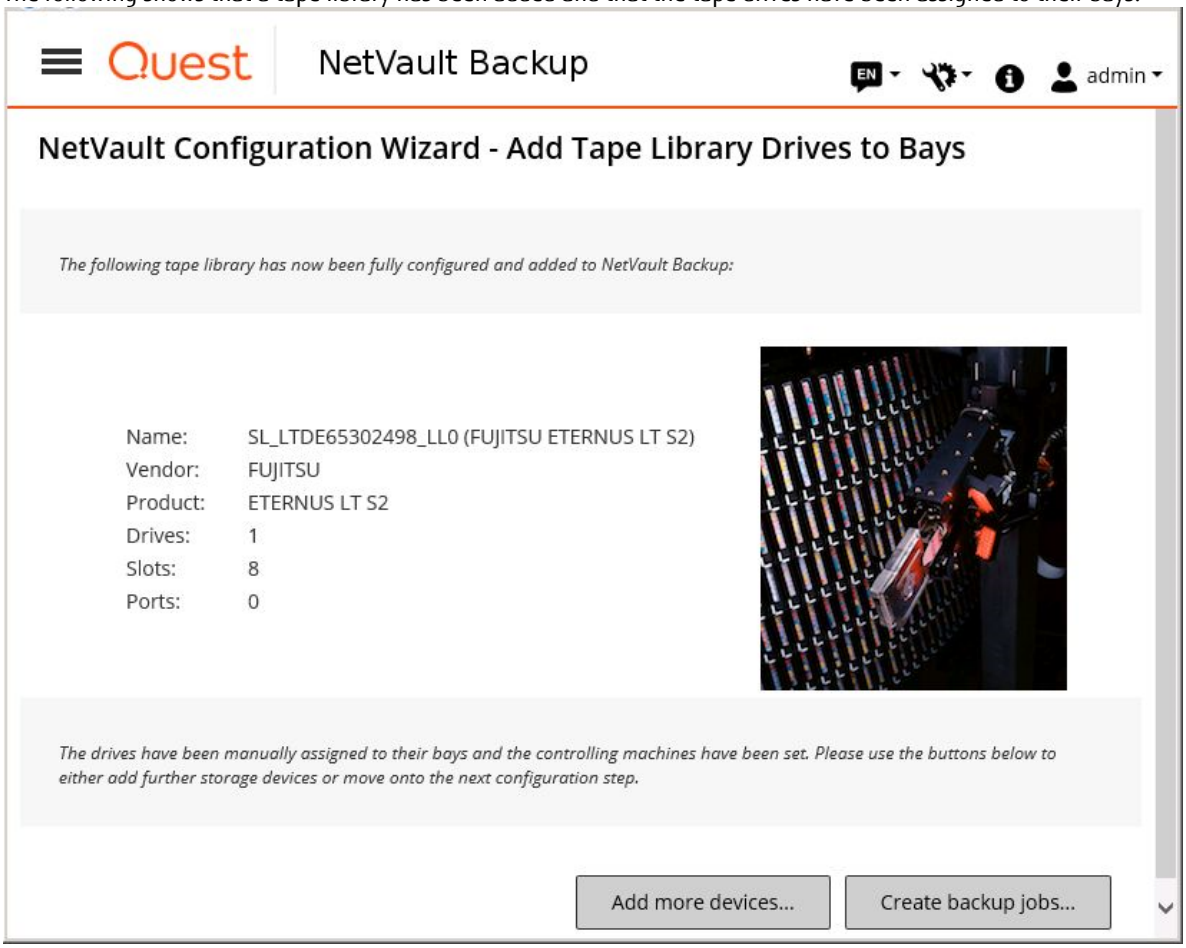
Add the tape library as a NetVault Backup storage device.
The NetVault Backup wizard is provided for easier configuration.
Log in to NetVault Backup WebUI and in the Navigation pane, click **Guided Configuration** and then **Add Storage Devices** to display the NetVault Storage Configuration Wizard - Add Storage Devices screen.



On the NetVault Storage Configuration Wizard - Add Storage Devices screen, select **Tape library/media changer** and then click the **Next** button.

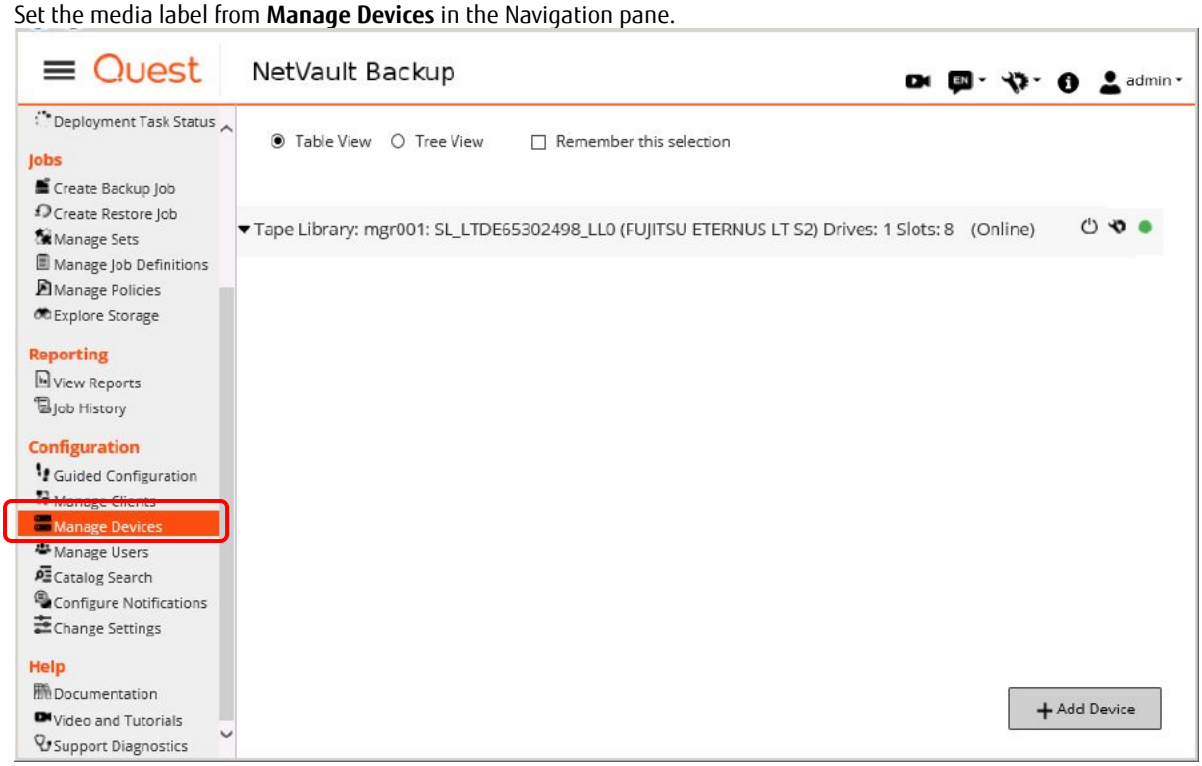
Follow the wizard to add a tape library and to assign tape drives to the bays of NetVault Backup.

The following shows that a tape library has been added and that the tape drives have been assigned to their bays.

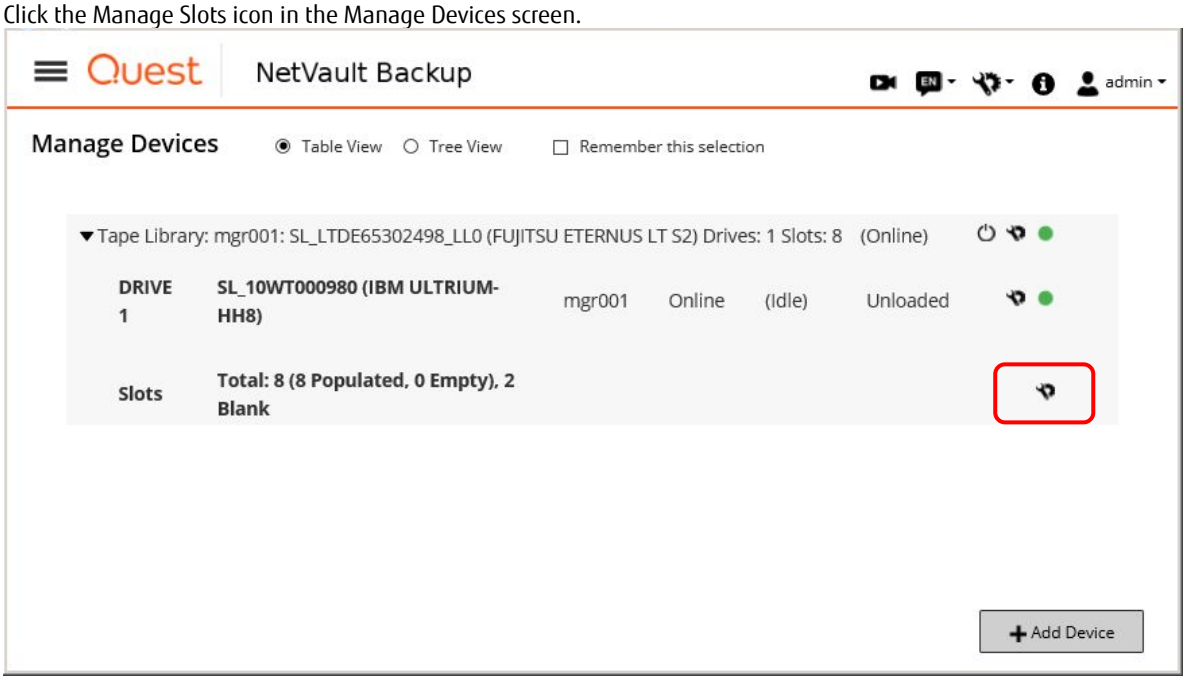


3.4.1.3. Setting the NetVault Backup Media Labels

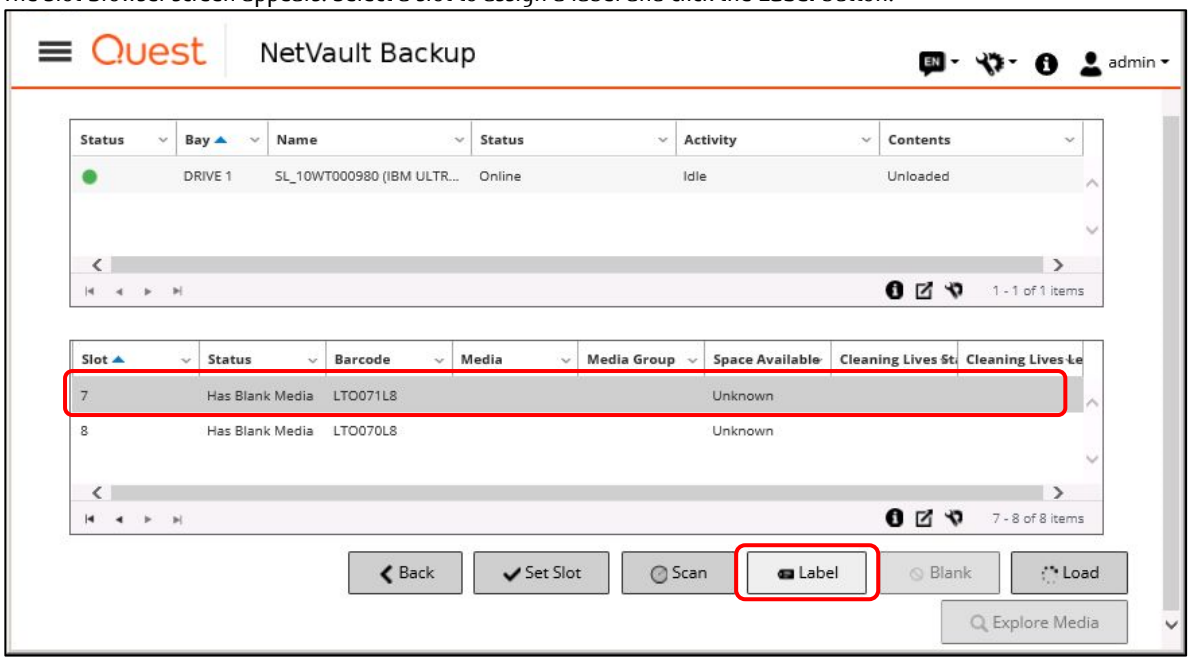
To manage multiple LTO media in NetVault Backup, assign labels to the slots that contain an LTO tape cartridge. Set the media label from **Manage Devices** in the Navigation pane.



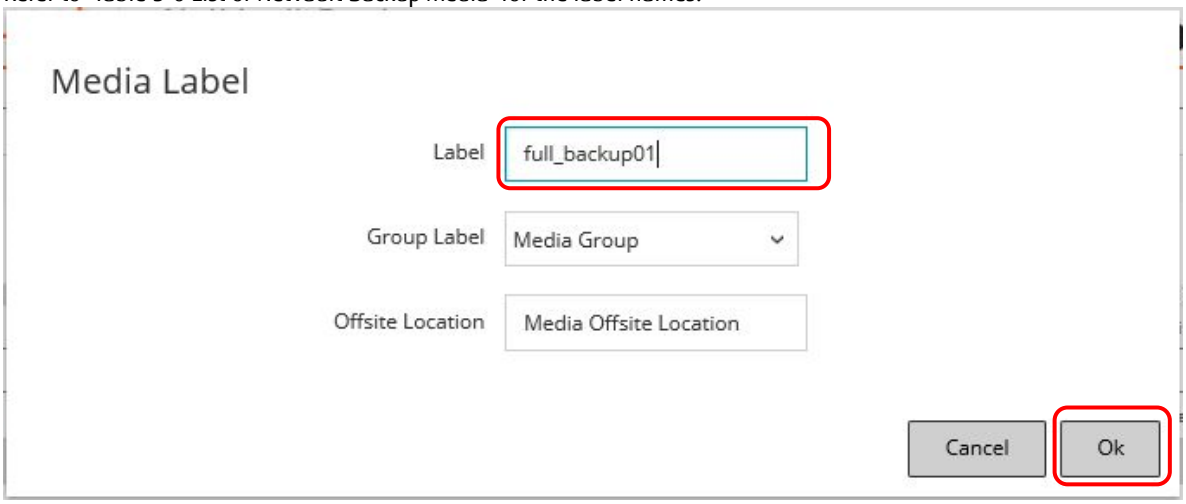
Click the Manage Slots icon in the Manage Devices screen.



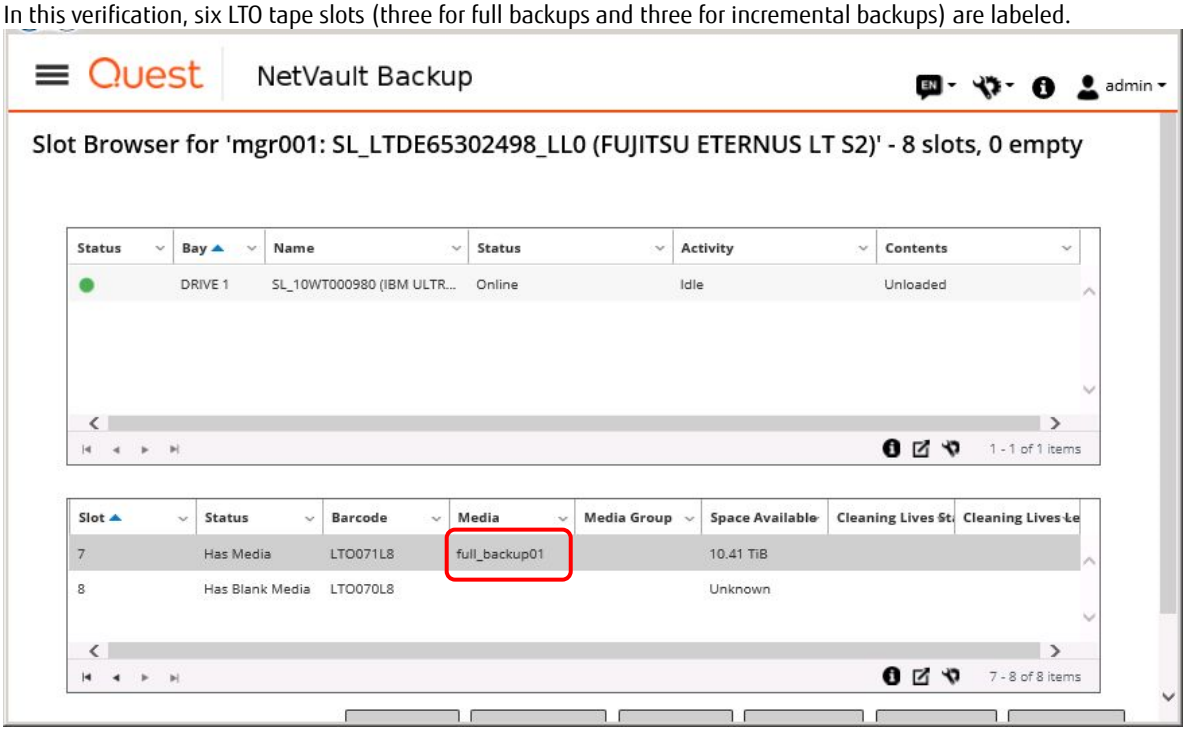
The Slot Browser screen appears. Select a slot to assign a label and click the **Label** button.



In the **Media Label** dialog box, enter the label name in the **Label** text box and then click the **OK** button.
Refer to "Table 3-6 List of NetVault Backup Media" for the label names.



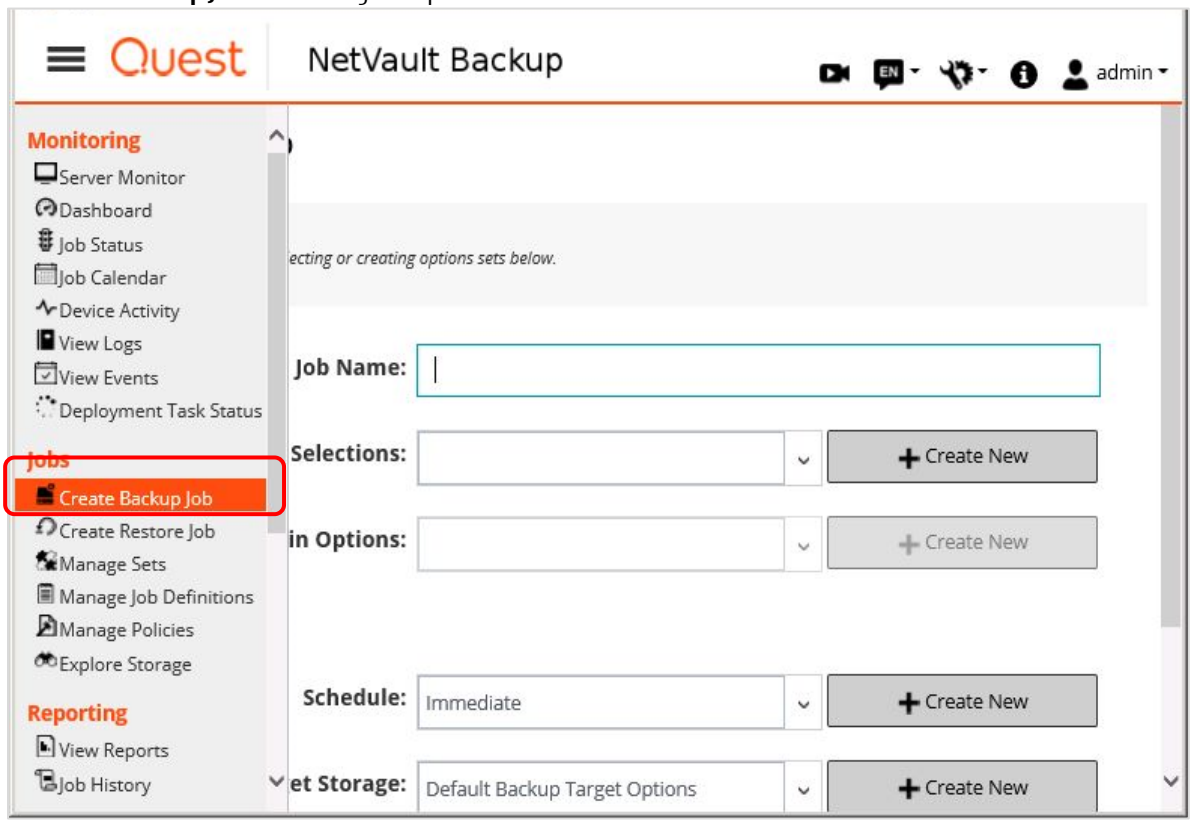
Check that the specified label name is displayed in the **Media** column of the Slot Browser page.
In this verification, six LTO tape slots (three for full backups and three for incremental backups) are labeled.



3.4.1.4. Backup Job Settings of NetVault Backup

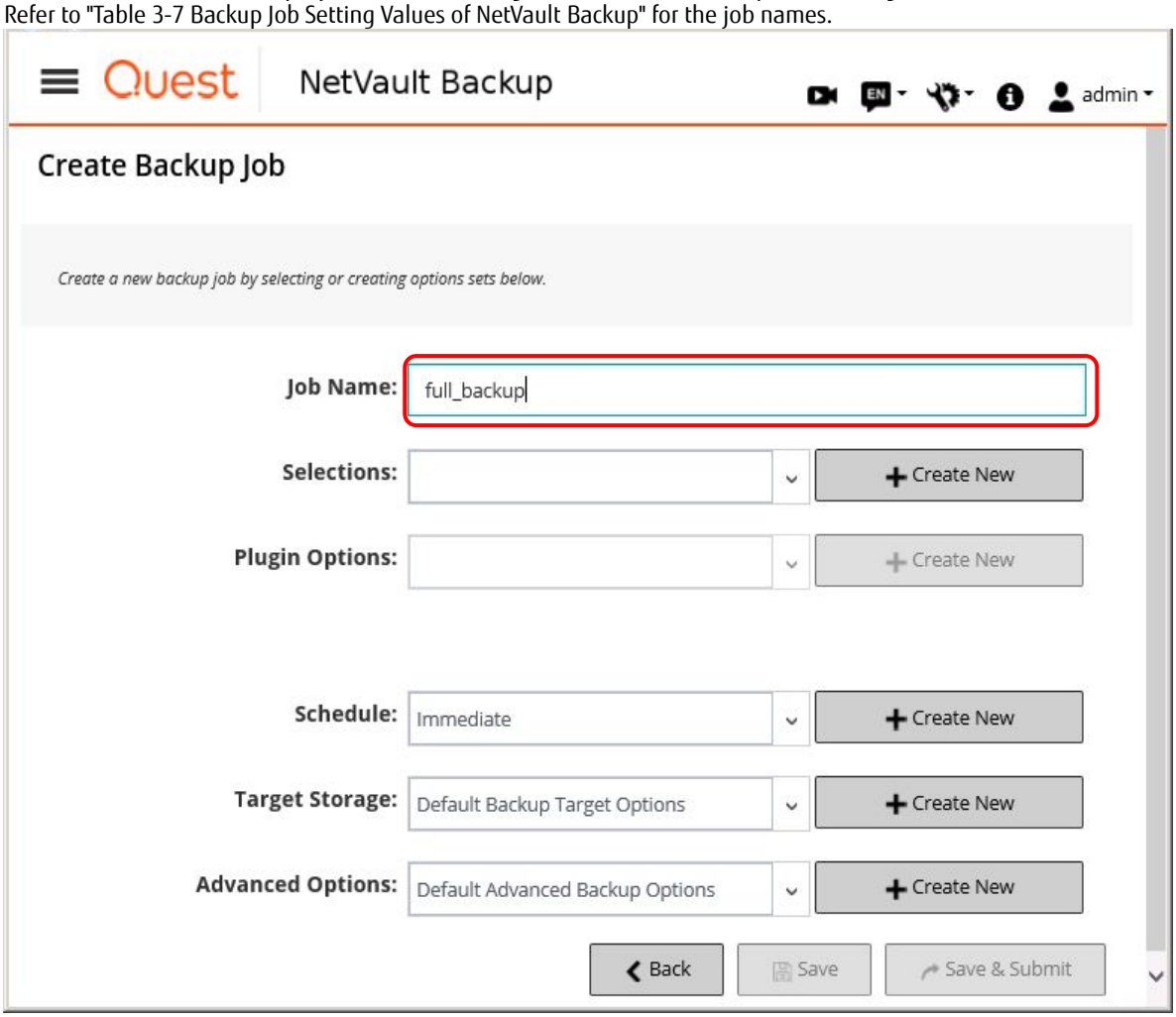
(1) Set a backup job to perform a full backup

For NetVault Backup, the backup settings can be performed on the Create Backup Job screen.
Click **Create Backup Job** in the Navigation pane.



Job Name, **Selections**, **Plugin Options**, **Schedule**, **Target Storage**, and **Advanced Options** can be set on the Create Backup Job screen.

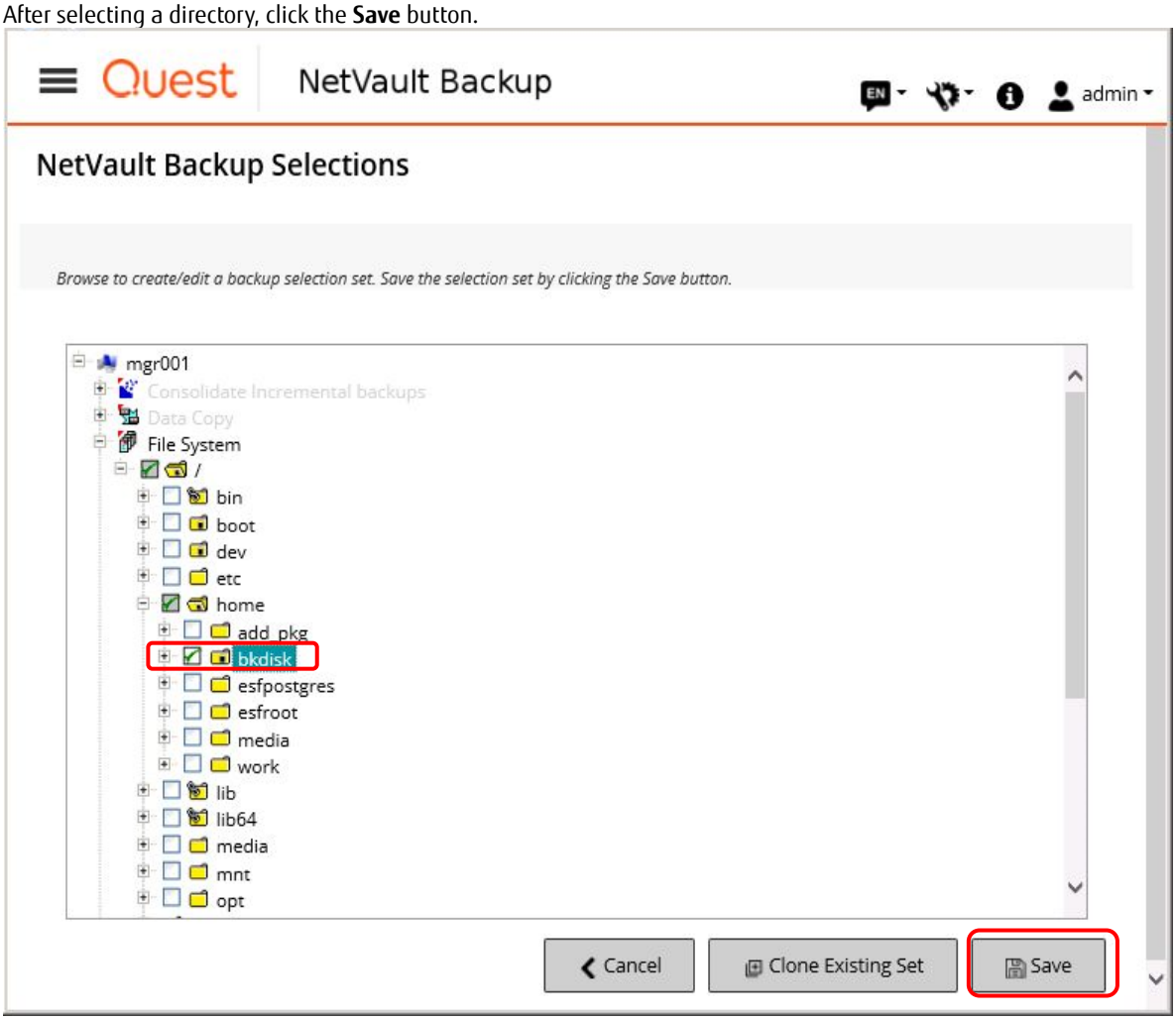
Enter a job name in **Job Name**.
In this verification, set a unique job name for three generations of full backups and three generations of incremental backups.
Refer to "Table 3-7 Backup Job Setting Values of NetVault Backup" for the job names.



In **Selections**, select the backup source directory of NetVault Backup.
To display the NetVault Backup Selections screen, click the **Create New** button next to the **Selections** list.

Select the checkbox of the backup target directory on the NetVault Backup Selections screen.

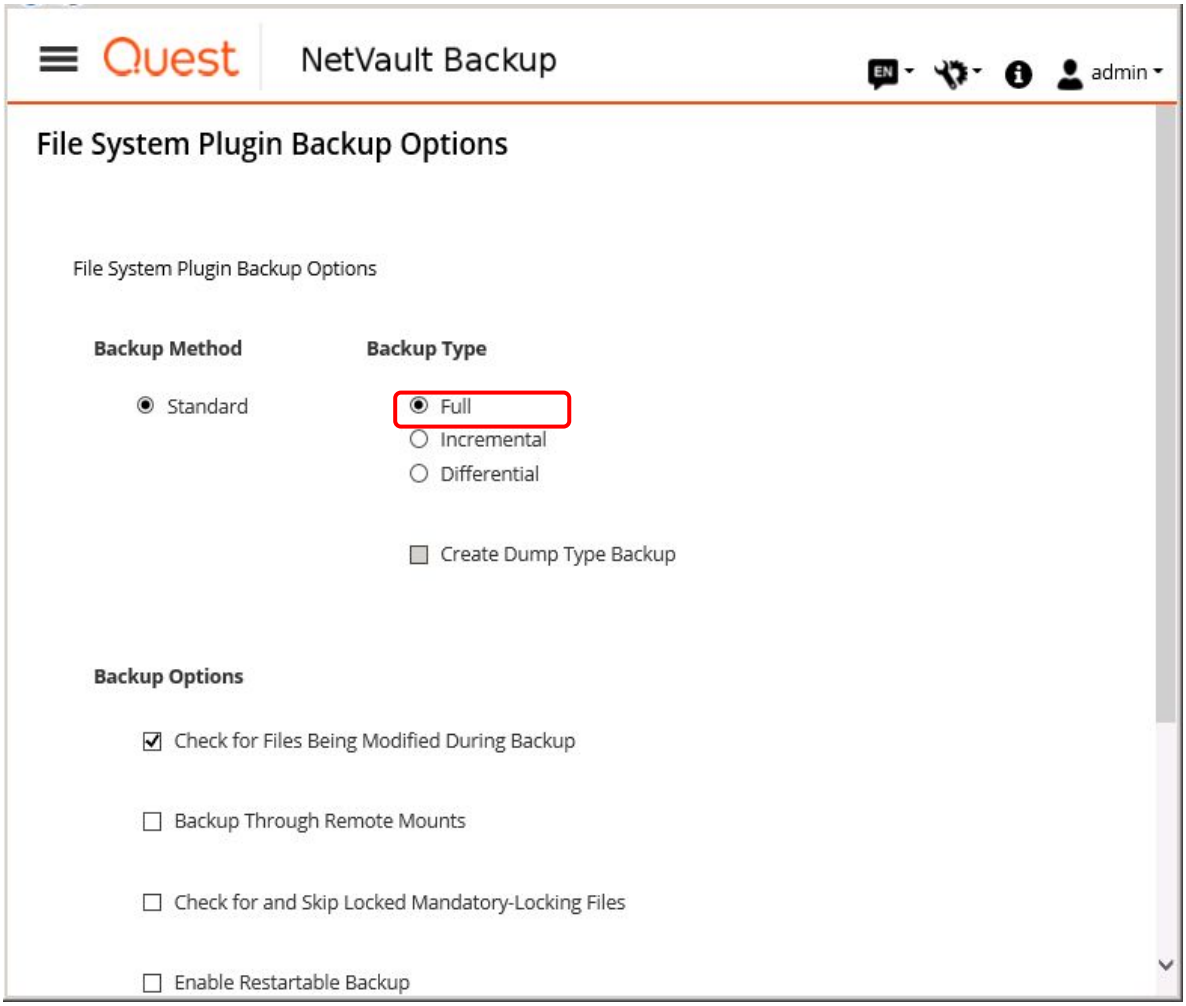
In this verification, assign the mount point /home/bkdisk to the ACM backup destination volume and use it as the backup source directory of NetVault Backup.
After selecting a directory, click the **Save** button.



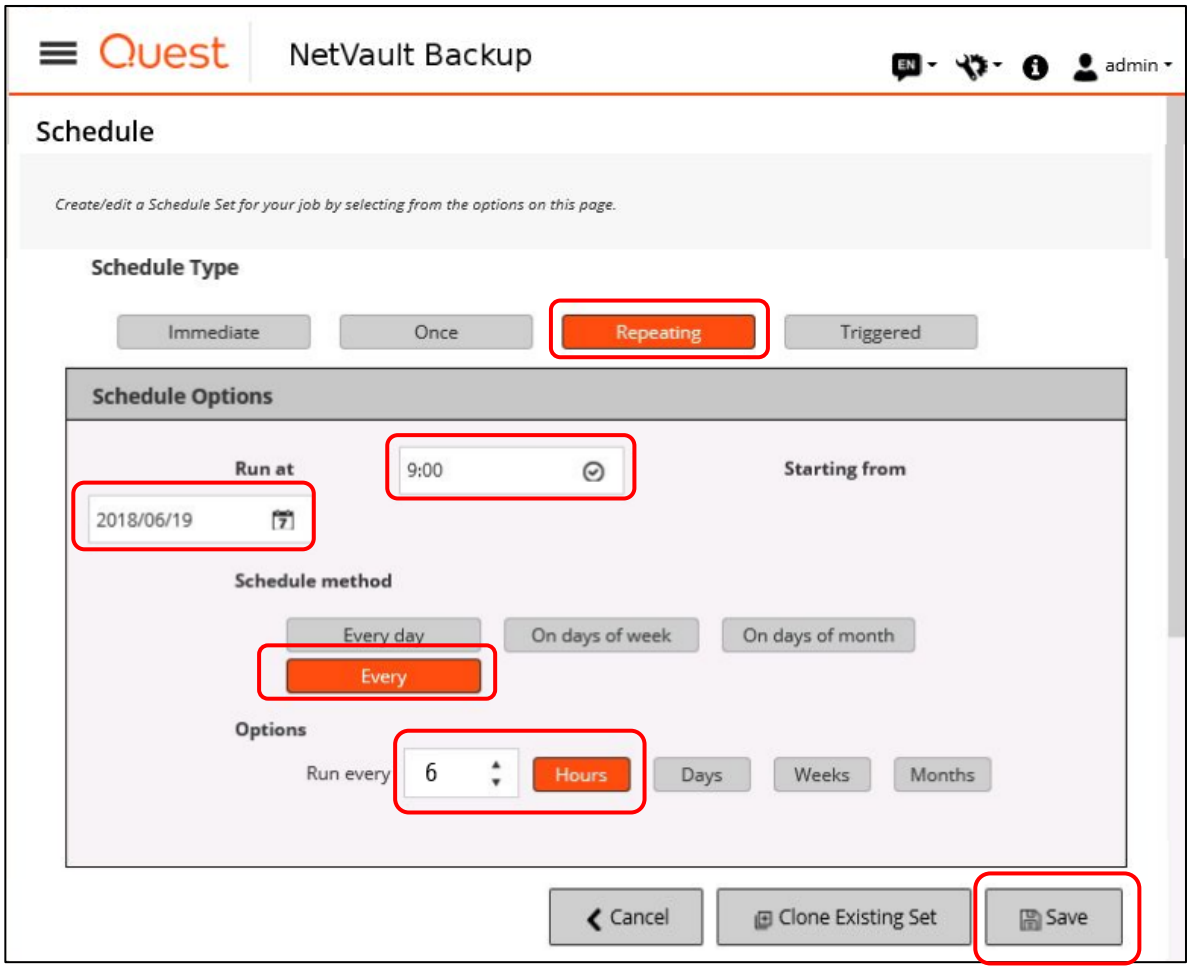
The **Create New Set** dialog box appears.
Enter the backup selection set name and then click the **Save** button.
Refer to "Table 3-7 Backup Job Setting Values of NetVault Backup" for the selection set names.

NetVault Backup assigns set names to manage each setting.
The instructions on how to create new sets are hereinafter omitted for brevity.

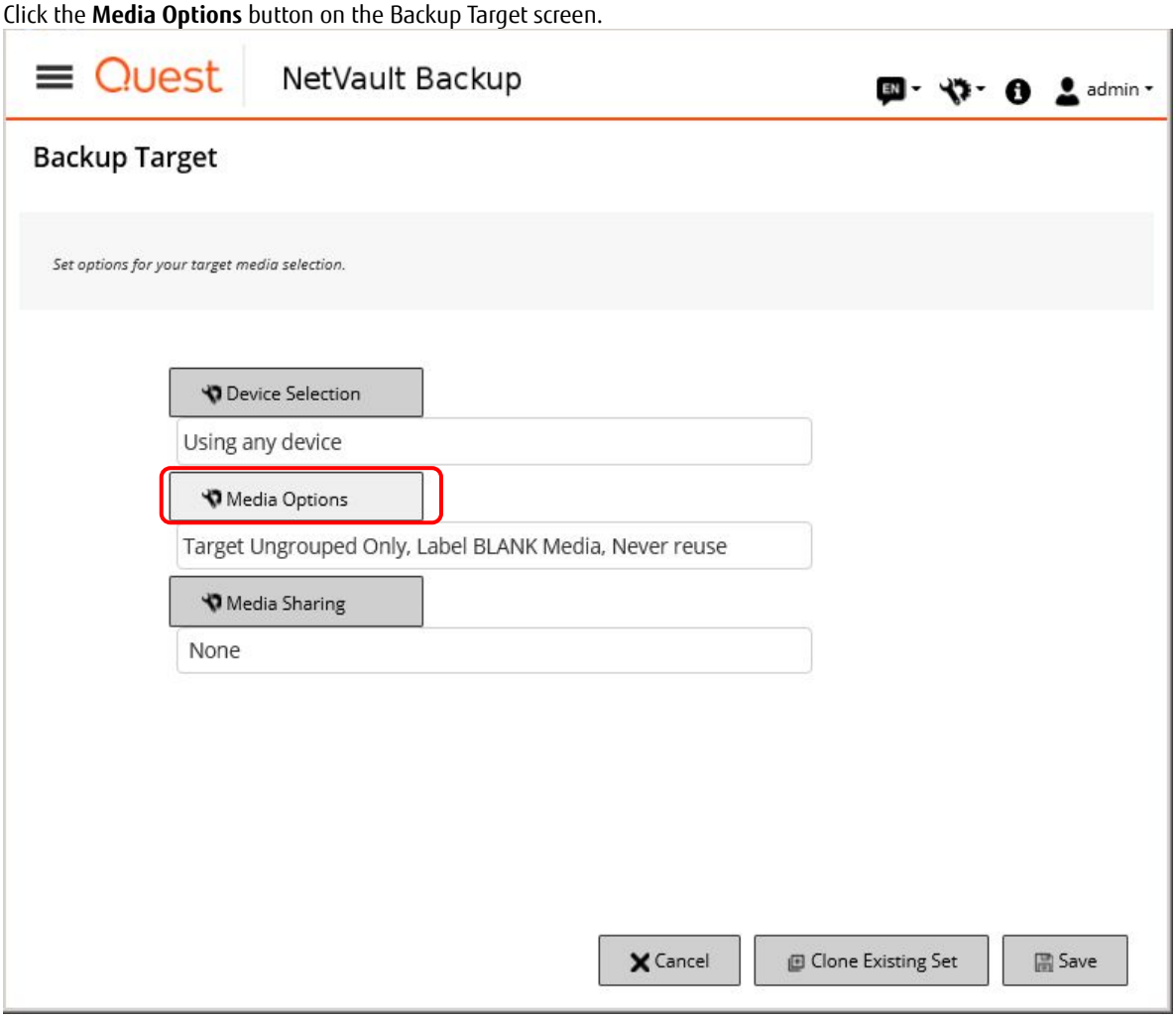
The backup method can be selected in **Plugin Options**.
To display the File System Plugin Backup Options screen, click the **Create New** button next to the **Plugin Options** list.
For full backups, select **Full** for **Backup Type**.



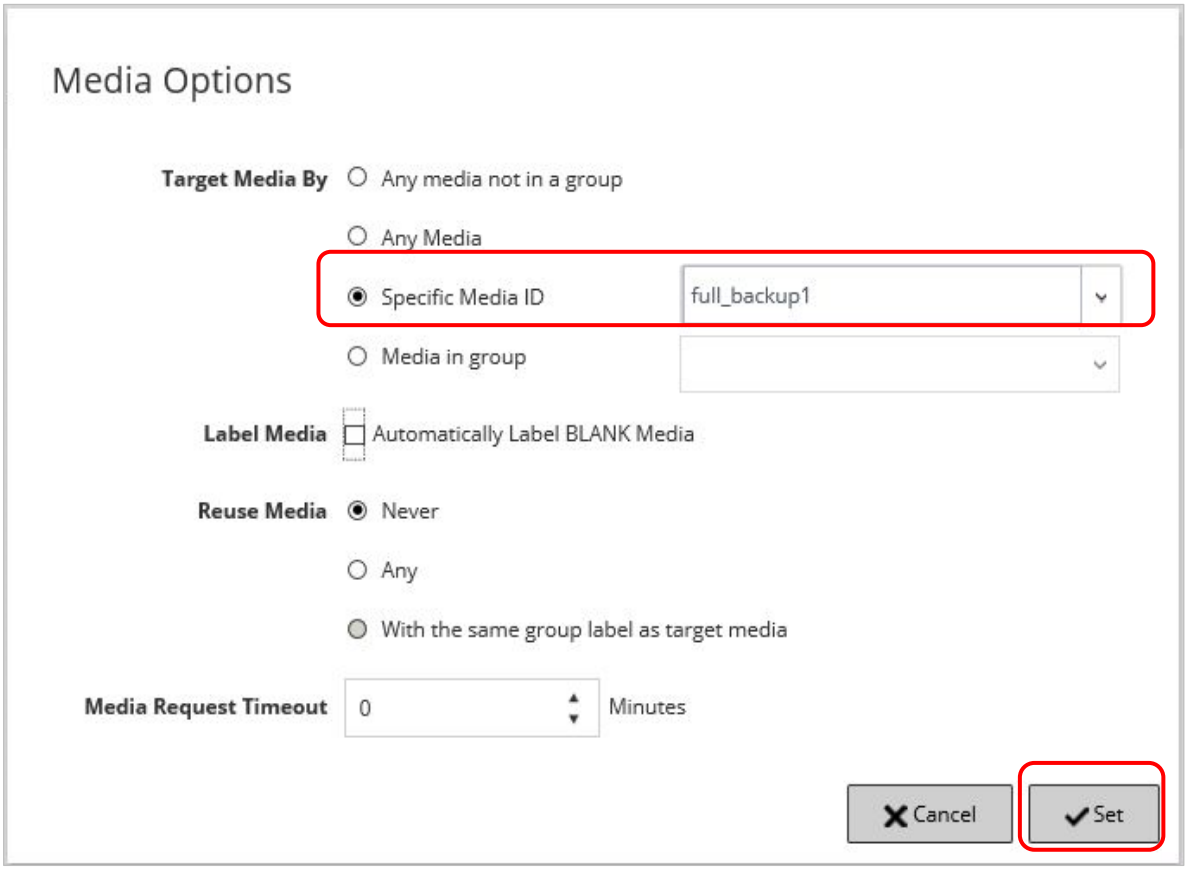
Startup schedules for backup jobs can be configured in **Schedule**.
To display the Schedule screen, click the **Create New** button next to the **Schedule** list.
Select the schedule type and schedule options, and then click the **Save** button.
The following shows an example of a schedule that runs a backup job every six hours.



Set the backup destination storage in **Target Storage**.
To display the Backup Target screen, click the **Create New** button next to the **Target Storage** list.
Click the **Media Options** button on the Backup Target screen.

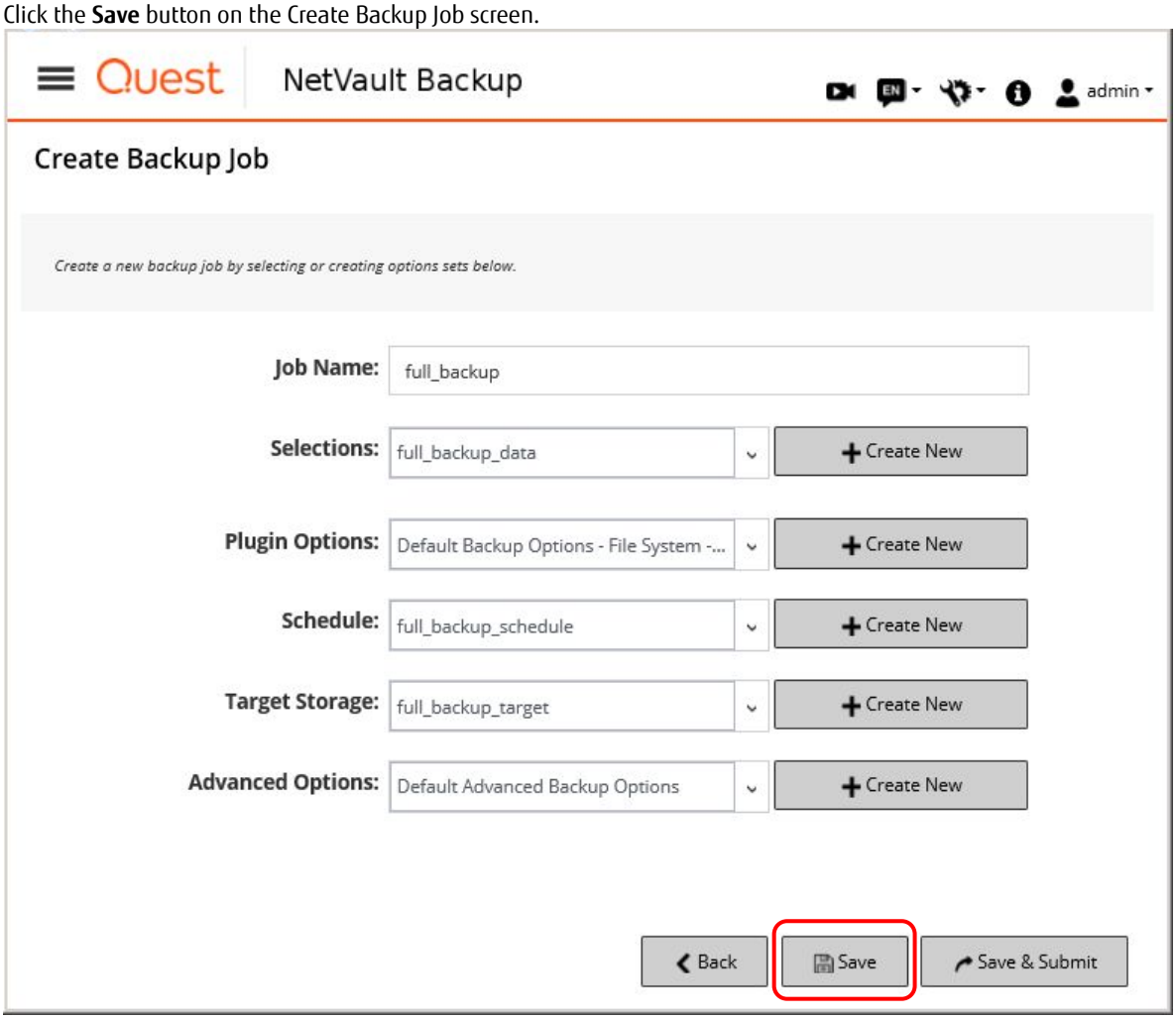


The **Media Options** dialog box appears.
Select **Specific Media ID** for **Target Media By**, enter the LTO tape slot label set in "3.4.1.3. Setting the NetVault Backup Media Labels ", and then click the **Set** button.

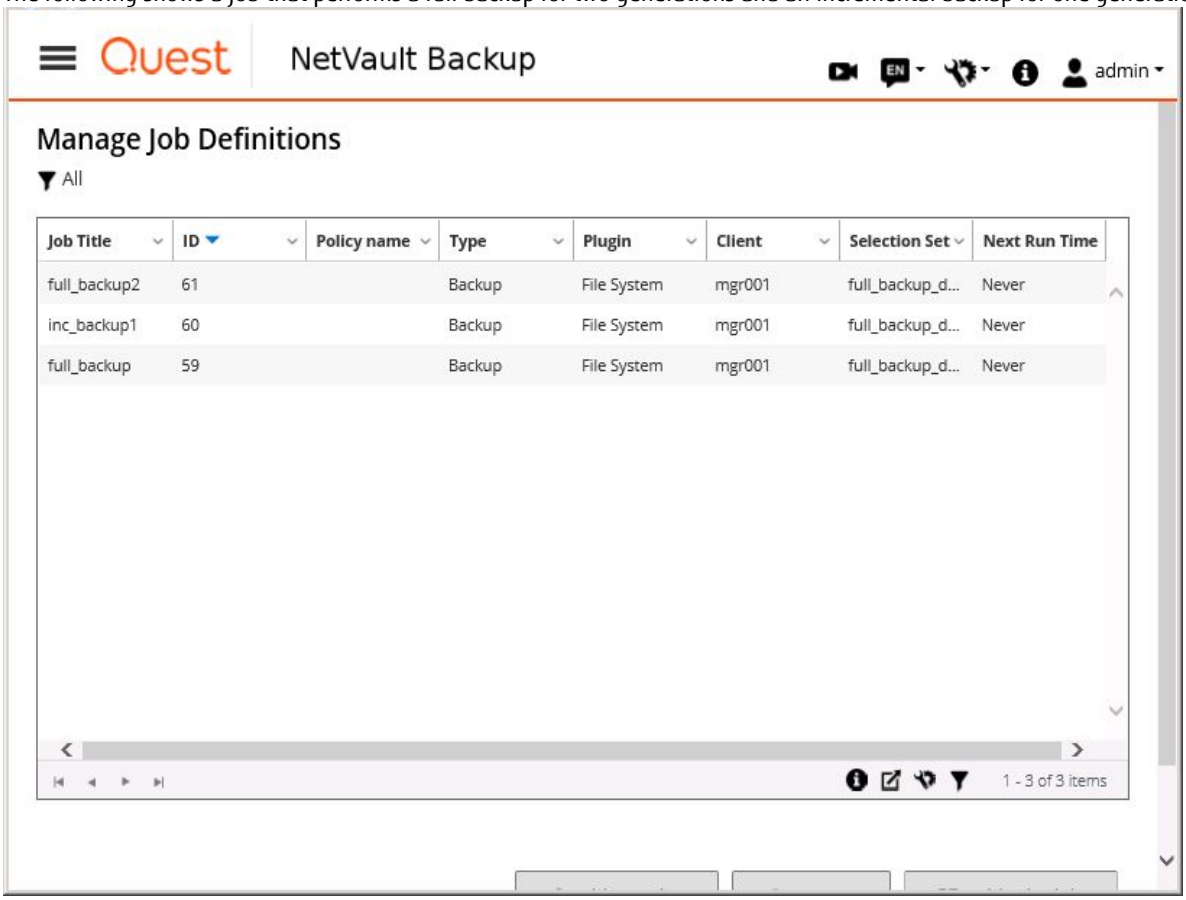


The settings related to discarding a backup can be configured in **Advanced Options**.
In this verification, the backups are not discarded so the default settings of Advanced Options are used.

Click the **Save** button on the Create Backup Job screen.



You can view the created backup job on the Manage Job Definitions screen.
Click **Manage Job Definitions** in the Navigation pane.
The following shows a job that performs a full backup for two generations and an incremental backup for one generation.

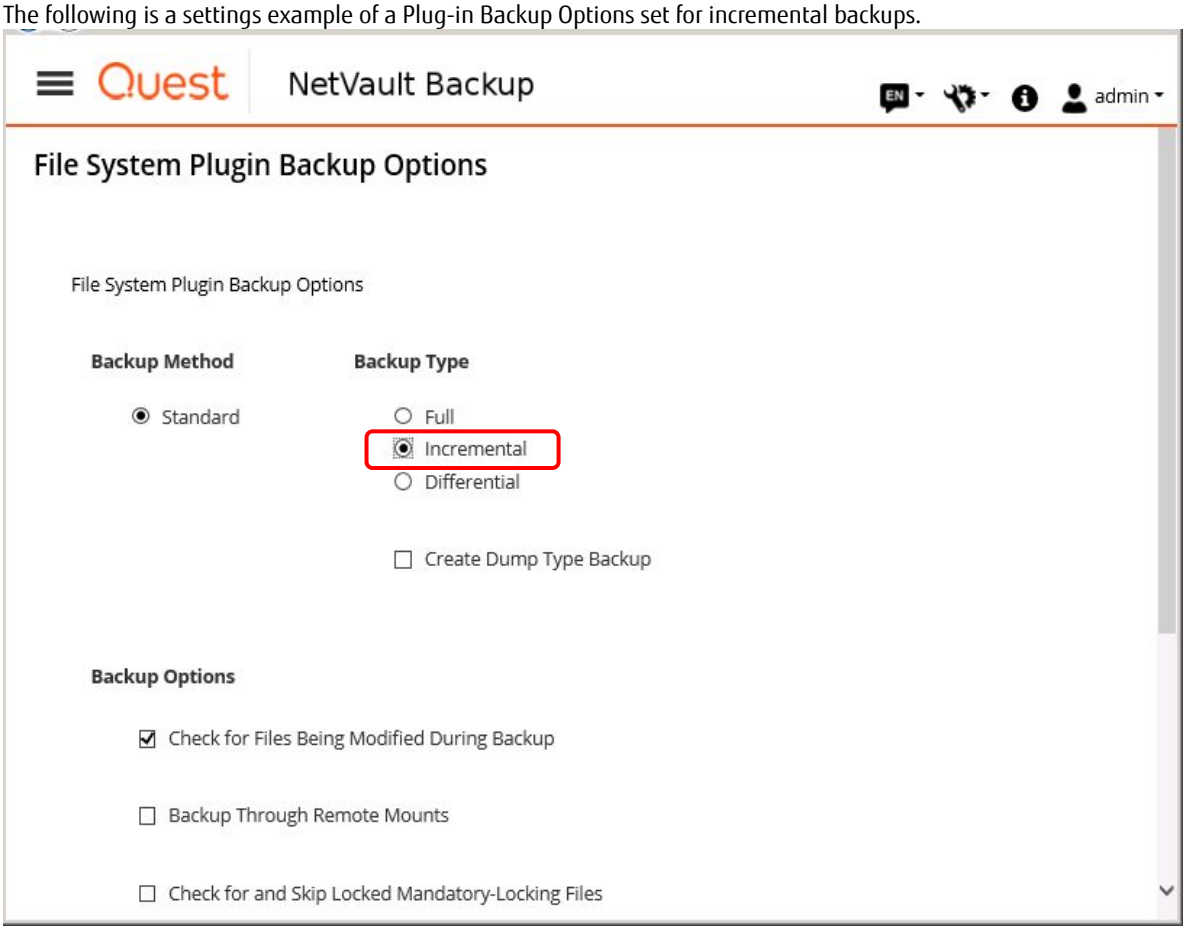


Each backup job starts automatically according to the time specified in **Schedule**.

(2) Set a backup job to perform an incremental backup

The steps to set an incremental backup job are similar to setting up a full backup job.
Unlike a full backup job, use the Plug-in Backup Options set for incremental backups by selecting **Incremental** for **Backup Type**.

The Plug-in Options set can be configured on the File System Plugin Backup Options screen.
The following is a settings example of a Plug-in Backup Options set for incremental backups.



Set backup jobs according to the actual operation. Examples of actual operations are as follows: operations that require alternating full backups and incremental backups with various generations on a weekly basis, operations that require reusing the same media, and operations that require removing media from the tape unit every week or every month and storing it in a storeroom for one year.
In addition, media has different life expectancies depending on the use count and the used environment. If the same media is reused, regular replacement of the media should be planned according to the operations requirements.

The following shows a backup job that stores two generations of backups (one generation per week) in which full backups are performed weekly and incremental backups are performed daily. To store two generations, a three-generation backup must be performed. In the setting example, three generations are backed up in media prepared for each generation, for full backups and for incremental backups. To prevent the media capacity from becoming depleted due to repeated backups, configure the settings so that only the two latest generations are each stored in a blank media and the older backups are discarded.

Week: Generation	Job Name	Execution Day of Week	Media Label	Target Directory	Backup Type Pages 22 and 28	Backup Life *3	Schedule (Run every) Page 23	Schedule (Starting from, Run at) Page 23
1st week: 1st generation	full_backup1	Sunday	full_backup01	/home/bkdisk	Full	Discard After: 2 Weeks	3 Weeks	9/2 1:00
	inc_backup1_mon	Monday	inc_backup01		Incremental	Discard After: 2 Weeks	3 Weeks	9/3 1:00
	inc_backup1_tue	Tuesday					3 Weeks	9/4 1:00
	inc_backup1_wed	Wednesday					3 Weeks	9/5 1:00
	inc_backup1_thr	Thursday					3 Weeks	9/6 1:00
	inc_backup1_fri	Friday					3 Weeks	9/7 1:00
	inc_backup1_sat	Saturday					3 Weeks	9/8 1:00
2nd week: 2nd generation	full_backup2	Sunday	full_backup02		Full	Discard After: 2 Weeks	3 Weeks	9/9 1:00
	inc_backup2_mon	Monday	inc_backup02		Incremental	Discard After: 2 Weeks	3 Weeks	9/10 1:00
	inc_backup2_tue	Tuesday					3 Weeks	9/11 1:00
	inc_backup2_wed	Wednesday					3 Weeks	9/12 1:00
	inc_backup2_thr	Thursday					3 Weeks	9/13 1:00
	inc_backup2_fri	Friday					3 Weeks	9/14 1:00
	inc_backup2_sat	Saturday					3 Weeks	9/15 1:00
3rd week: 3rd generation	full_backup3	Sunday	full_backup03		Full	Discard After: 2 Weeks	3 Weeks	9/16 1:00
	inc_backup3_mon	Monday	inc_backup03		Incremental	Discard After: 2 Weeks	3 Weeks	9/17 1:00
	inc_backup3_tue	Tuesday					3 Weeks	9/18 1:00
	inc_backup3_wed	Wednesday					3 Weeks	9/19 1:00
	inc_backup3_thr	Thursday					3 Weeks	9/20 1:00
	inc_backup3_fri	Friday					3 Weeks	9/21 1:00
	inc_backup3_sat	Saturday					3 Weeks	9/22 1:00

Table 3-9 Setting Example of a Three Generation Backup with Full and Incremental Backups

*3: The backup life can be set by creating a new Advanced Options set and with the **Backup Life** dialog box.

3.4.1.5. ACM Backup Execution

(1) Unmount the backup volume
Before performing a backup with ACM, unmount the backup volume (/dev/sdb1) from the backup server to prevent access.
From the command prompt of the backup server, execute the **umount** command.

```
# umount /dev/sdb1
#
```

(2) Execute a backup
From the command prompt of the backup server, execute **swsrpmake** to perform a backup from the source volume (/dev/sdb1) to the destination volume (/dev/sdb1).
The -T option of **swsrpmake** specifies QuickOPC.

```
# /opt/FJSVswsrp/bin/swsrpmake -h GYOM01 -T /dev/sdb1@GYOM01 /dev/sdb1@MGR001
FROM=/dev/sdb1@GYOM01, TO=/dev/sdb1@MGR001 swsrpmake completed
#
```

(3) Check the progress of the backup
Check the progress of the backup by executing **swsrpstat** (operation status display command).
You can check the progress of the replication under the **Execute** column.

```
# /opt/FJSVswsrp/bin/swsrpstat -h GYOM01 -L /dev/sdb1@GYOM01
Server Original-Volume  Replica-Volume   Direction Status Execute Trk Update Rcv  Split Xfer Sna
p-Gen
GYOM01 /dev/sdb1@GYOM01 /dev/sdb1@MGR001 regular   snap   50%     on  ----   ---- ----  ---- ---
-
#
```

When the backup is completed, the **Status** and **Execute** columns become "----".

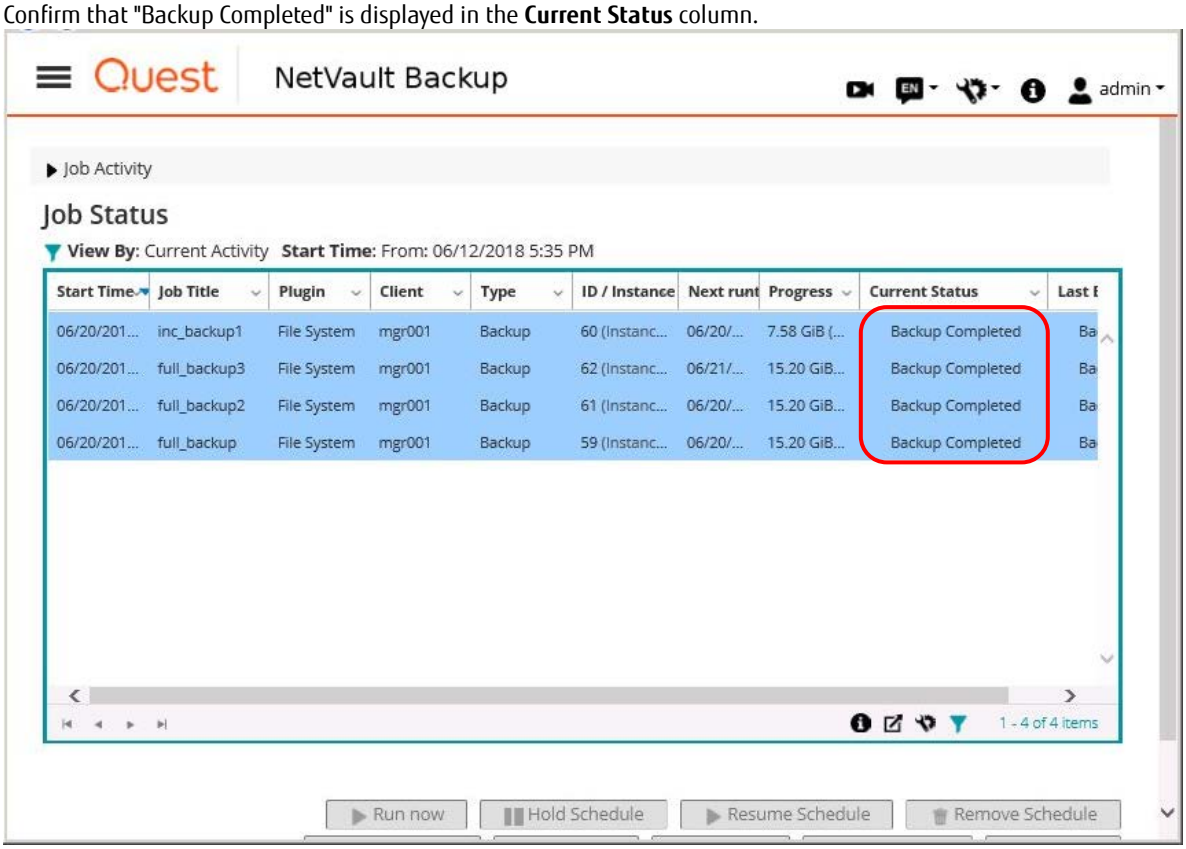
```
# /opt/FJSVswsrp/bin/swsrpstat -h GYOM01 -L /dev/sdb1@GYOM01
Server Original-Volume  Replica-Volume   Direction Status Execute Trk Update Rcv  Split Xfer Sna
p-Gen
GYOM01 /dev/sdb1@GYOM01 /dev/sdb1@MGR001 regular   ----   ----    on  0%     ---- ----  ---- ---
-
```

(4) Mount the backup volume
From the command prompt of the backup server, mount the destination volume (/dev/sdb1) to the mount point (/home/bkdisk) as a backup volume by executing the **mount** command.

```
# mount -t xfs /dev/sdb1 /home/bkdisk
#
```

3.4.1.6. Verification of the Backup Results

Check the result to confirm that the NetVault Backup backup jobs configured to start automatically were performed according to the schedule.
Click **Job Status** in the Navigation pane to display the Job Activity screen.
Confirm that "Backup Completed" is displayed in the **Current Status** column.



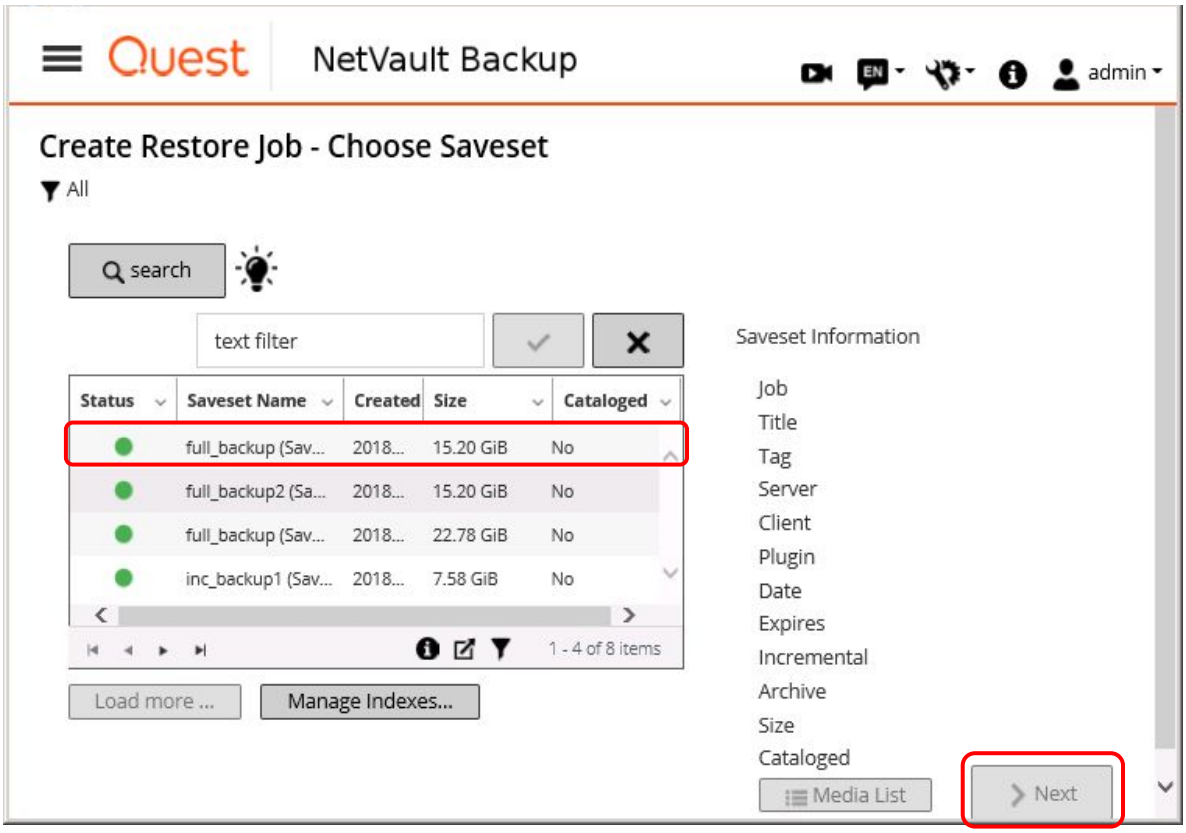
3.4.2. Restore Verification Procedure

This section describes the restore verification procedure using ACM and NetVault Backup.

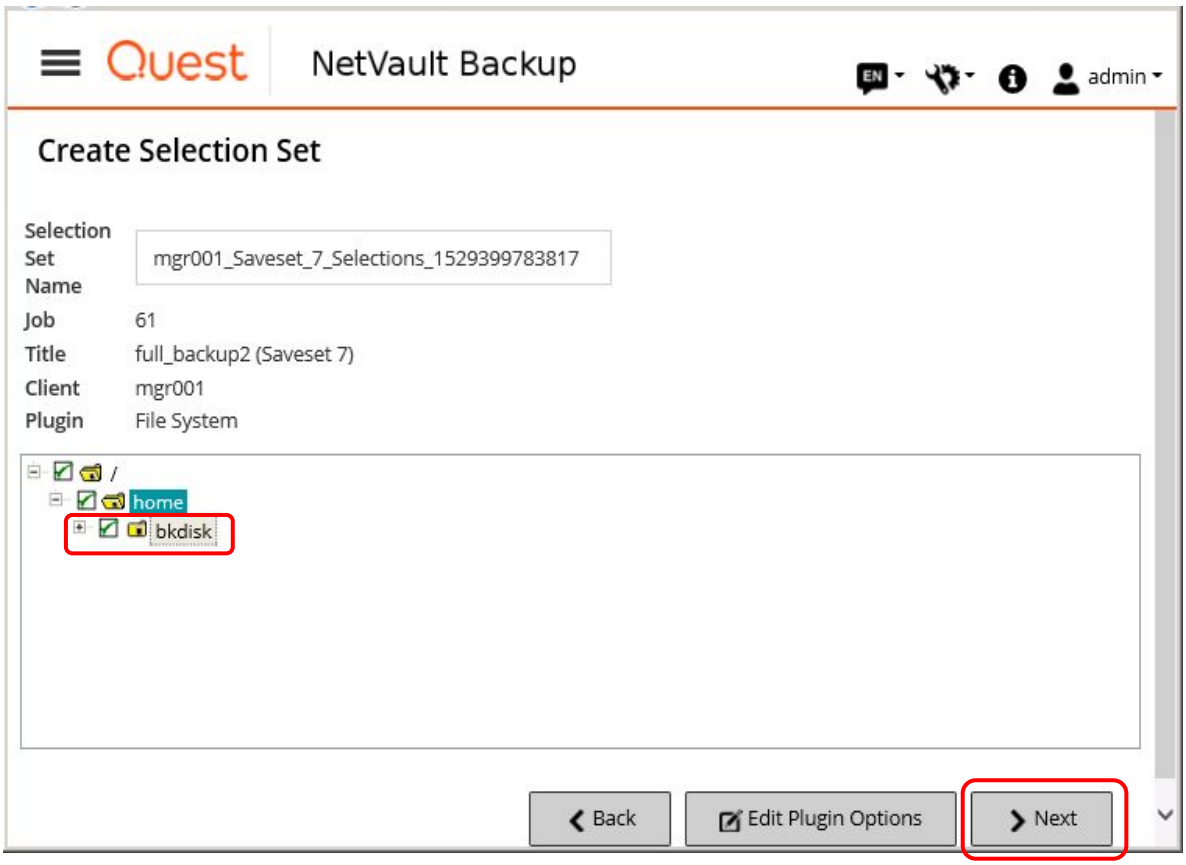
3.4.2.1. Restore Job Settings of NetVault Backup

Empty the restore destination directory (/home/bkdisk) in advance.

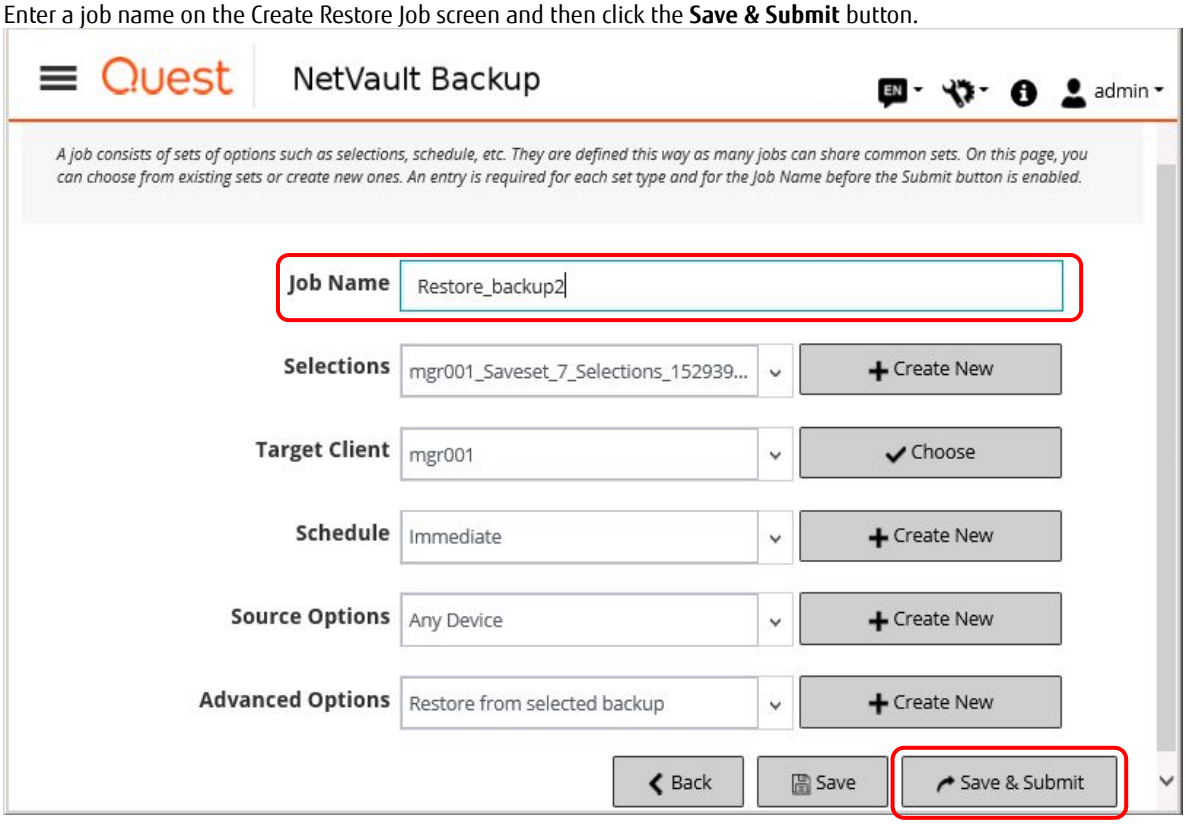
In NetVault Backup, create a restore job and execute a restore.
Click **Create Restore Job** in the Navigation pane to display the Create Restore Job - Choose Saveset screen.
Select a saveset to restore and then click the **Next** button.



The Create Selection Set screen appears.
Select the restore destination directory and then click the **Next** button.

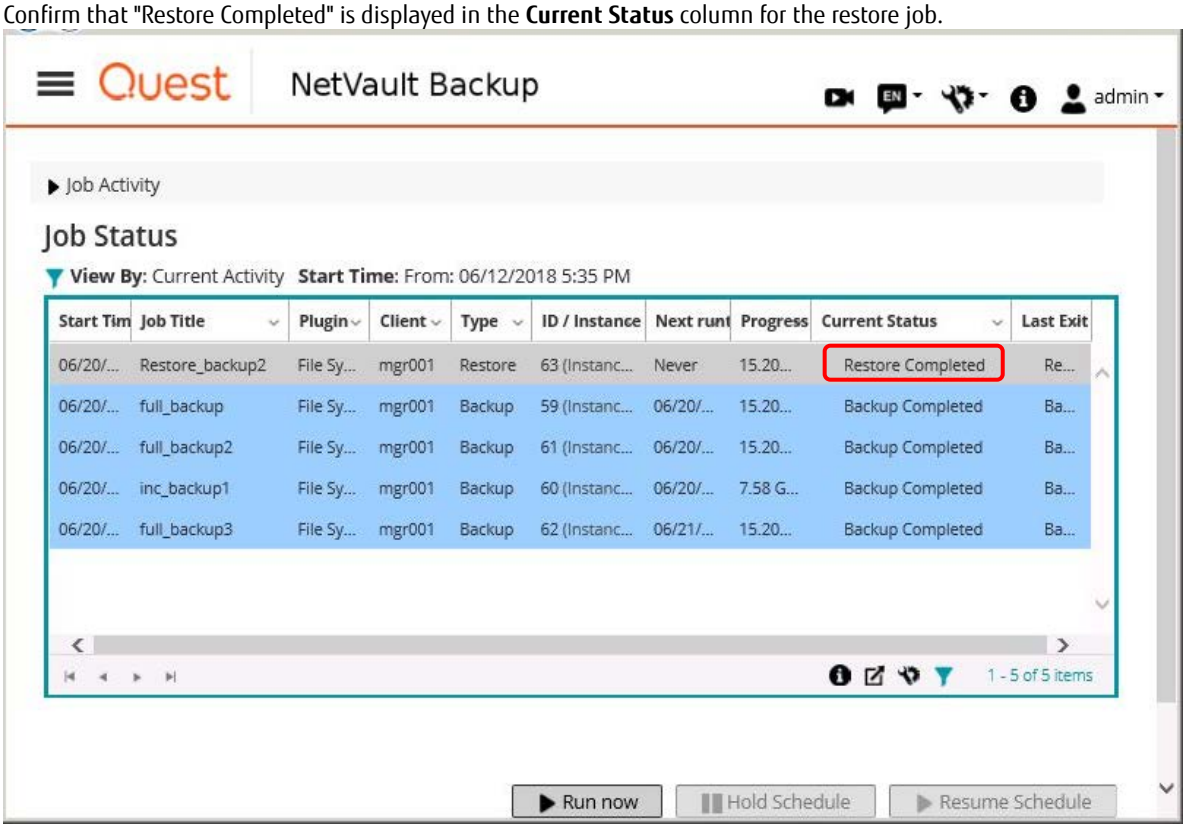


Enter a job name on the Create Restore Job screen and then click the **Save & Submit** button.



3.4.2.2. Verification of the Restore Results

Check the execution result of the restore job.
Click **Job Status** in the Navigation pane to display the Job Activity screen.
Confirm that "Restore Completed" is displayed in the **Current Status** column for the restore job.



A directory list of the destinations can be obtained to confirm that the backed up files are displayed.

3.4.2.3. Configuration of ACM

(1) Delete the source and destination volumes
From the command prompt of the backup server, delete the settings for the source and destination volumes used for the backup by executing **swsrpdelvol** (replication volume information deletion command).

```
# /opt/FJSVswsrp/bin/swsrpdelvol -h GYOM01 /dev/sdb1@GYOM01 /dev/sdb1@MGR001
swsrpdelvol completed
#
```

(2) Set the source and destination volumes
Set the source and destination volumes to be used for the restore.
Execute **swsrpsetvol** to set the device name /dev/sdb1 as the source volume (backup server) and the device name /dev/sdb1 as the destination volume (business server).

```
# /opt/FJSVswsrp/bin/swsrpsetvol -n -o ORG -u /dev/sdb1 /dev/sdb1@GYOM01
swsrpsetvol completed
#
```

Execute **swsrpvolinfo** to confirm the settings.

```
# /opt/FJSVswsrp/bin/swsrpvolinfo -h GYOM01
Server Original-Volume  Size        Replica-Volume   Size        Copy          Op-Server
GYOM01 /dev/sdb1@MGR001  599.9 Gbyte /dev/sdb1@GYOM01  499.9 Gbyte uni-direction original
#
```

3.4.2.4. ACM Restore Execution

(1) Execute a restore
Execute a restore from the source volume (/dev/sdb1) to the destination volume (/dev/sdb1) by executing **swsrpmake**.
For **swsrpmake**, specification of the -T option is not available so OPC is executed.

```
# /opt/FJSVswsrp/bin/swsrpmake /dev/sdb1@MGR001 /dev/sdb1@GYOM01
FROM=/dev/sdb1@MGR001, TO=/dev/sdb1@GYOM01 swsrpmake completed
#
```

(2) Check the progress of the restore
Check the progress of the restore by executing **swsrpstat**.
You can check the progress of the replication under the **Execute** column.

```
# /opt/FJSVswsrp/bin/swsrpstat /dev/sdb1@MGR001
Server Original-Volume  Replica-Volume   Direction Status Execute
MGR001 /dev/sdb1@MGR001 /dev/sdb1@GYOM01 regular   snap   72%
#
```

When the restore is completed, the **Status** and **Execute** columns become "----".

```
# /opt/FJSVswsrp/bin/swsrpstat /dev/sdb1@MGR001
Server Original-Volume  Replica-Volume   Direction Status Execute
MGR001 /dev/sdb1@MGR001 /dev/sdb1@GYOM01 ----      ----   ----
#
```

3.4.2.5. ACM Restore Result Verification

Upon completion of the restore, confirm that the restored data exists in the restore destination directory of the business server.

3.5. Verification Result

For the production volume on the all-flash array used with ACM and NetVault Backup, the three-generation backup was acquired and both full and incremental backups were successfully acquired for each generation.

A restore was performed to the business volume using the backup data in the LTO tape unit via the backup volume and a successful restore was confirmed.

Full backup verification result

Backup Generation	Backup Method		LTO	Verification Result
	Production volume → Backup volume	Backup volume → LTO tape cartridge		
1st generation	Execute **swsrpmake**	Start backup job #1 of NetVault Backup (full backup)	full_backup01	Successful completion of **swsrpmake** Backup job #1 of NetVault Backup started automatically and was successfully completed.
2nd generation	Execute **swsrpmake**	Start backup job #2 of NetVault Backup (full backup)	full_backup02	Successful completion of **swsrpmake** Backup job #2 of NetVault Backup started automatically and was successfully completed.
3rd generation	Execute **swsrpmake**	Start backup job #3 of NetVault Backup (full backup)	full_backup03	Successful completion of **swsrpmake** Backup job #3 of NetVault Backup started automatically and was successfully completed.

Table 3-10 Full backup verification result

Incremental backup verification result

Backup Generation	Backup Method		LTO	Verification Result
	Production volume → Backup volume	Backup volume → LTO tape cartridge		
1st generation	Execute **swsrpmake**	Start backup job #1 of NetVault Backup (incremental backup)	inc_backup01	Successful completion of **swsrpmake** Backup job #1 of NetVault Backup started automatically and was successfully completed.
2nd generation	Execute **swsrpmake**	Start backup job #2 of NetVault Backup (incremental backup)	inc_backup02	Successful completion of **swsrpmake** Backup job #2 of NetVault Backup started automatically and was successfully completed.
3rd generation	Execute **swsrpmake**	Start backup job #3 of NetVault Backup (incremental backup)	inc_backup03	Successful completion of **swsrpmake** Backup job #3 of NetVault Backup started automatically and was successfully completed.

Table 3-11 Incremental Backup Verification Method

Restore verification result

Restore Generation	LTO	Restore Method		Verification Result
		LTO tape unit → Backup volume	Backup volume → Production volume	
Full backup of the 2nd generation	full_backup02	Start the restore job by specifying the target NetVault Backup full backup saveset	Execute OPC	Successful completion of NetVault Backup restore job Successful completion of **swsrpmake** The backed up production volume was restored.

Table 3-12 Restore verification result

4. Conclusion

Performing backups using an all-flash array and an LTO tape unit reduces the purchase cost associated with generation backup storage by replacing flash storage with LTO tape cartridges. In addition, since the business data stored on the flash storage can be saved to the backup flash storage at high speed, this method has the benefit of no business downtime. Use of the data protection product NetVault Backup allows users to set tape units and perform backup and restore operations with a user-friendly UI.
Reduce backup costs by taking advantage of the benefits provided by the all-flash array, LTO tape unit, and NetVault Backup combination.

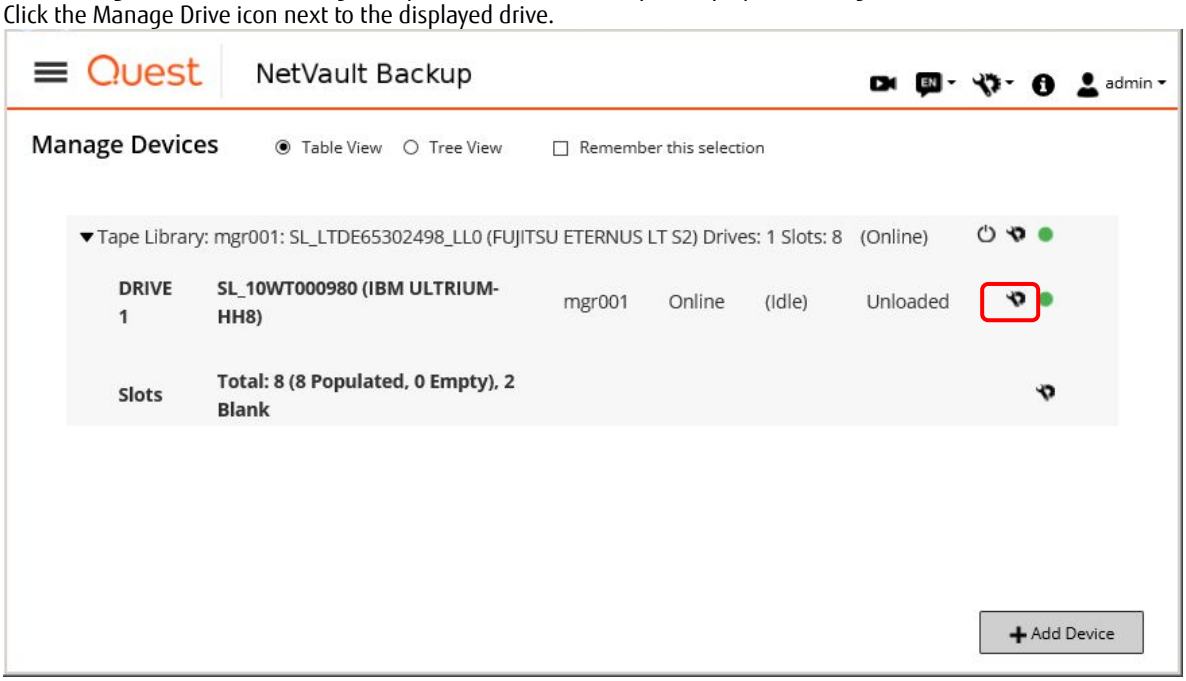
Appendix Cleaning Operation Procedure

Tape libraries require periodic cleaning of the tape head.
NetVault Backup has an automatic cleaning function that uses a cleaning tape cartridge for tape libraries.
The setup procedure for the automatic cleaning is described below.

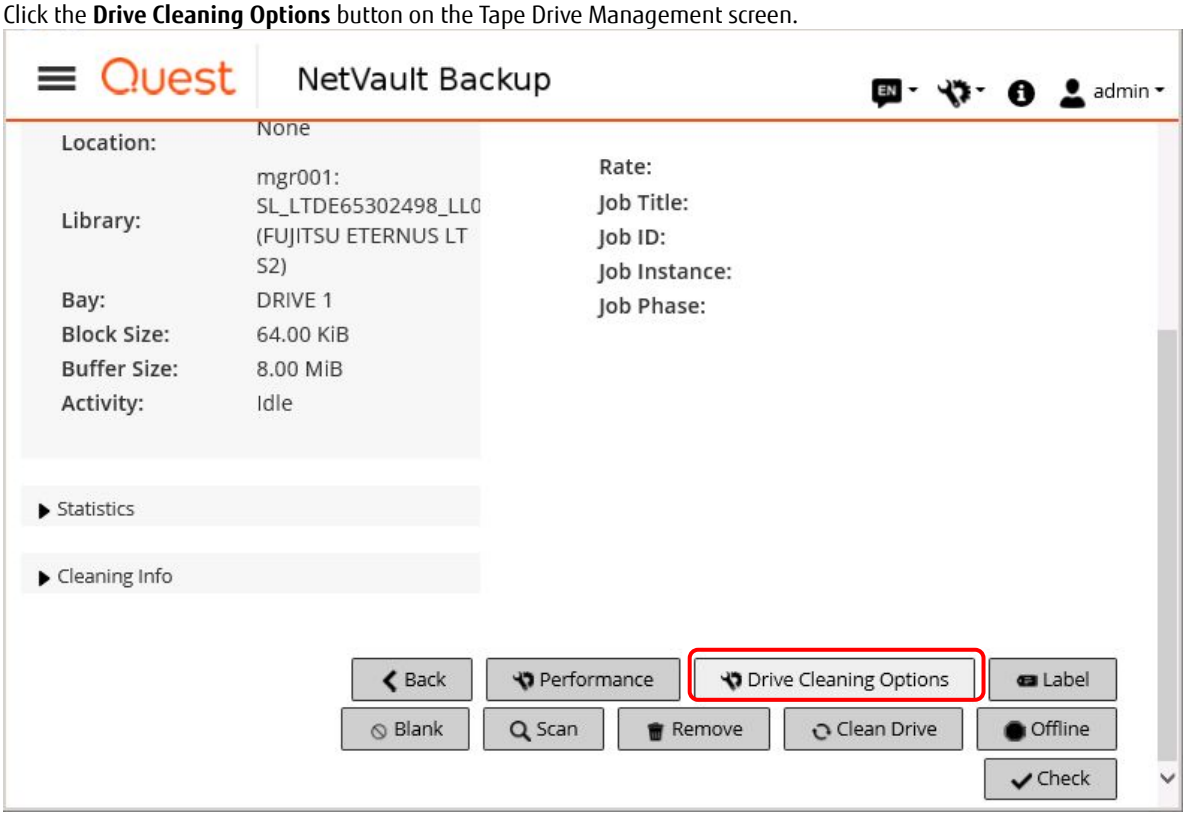
To use the NetVault Backup cleaning function, the settings for the tape library and drives must be configured in advance.
For the setting procedures, refer to the NetVault section of the *User's Guide -Server Connection-* product manual of the respective tape libraries.

Place a cleaning tape cartridge in the cleaning slot and then perform the following procedure.

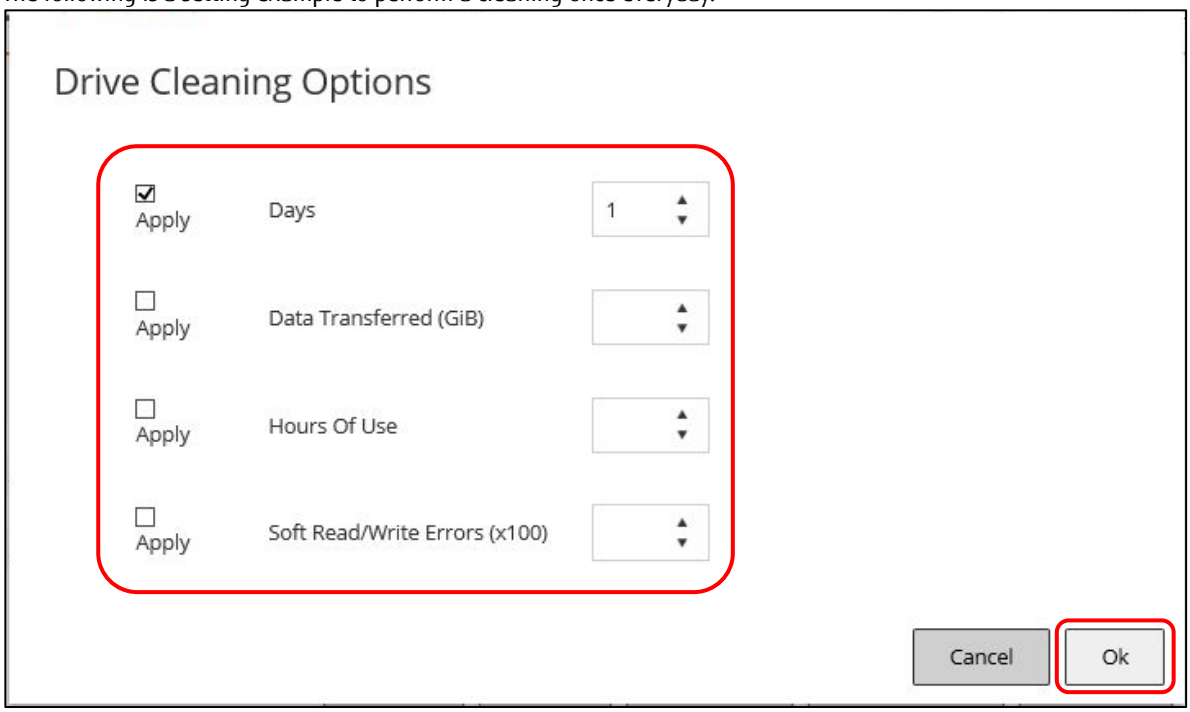
Click **Manage Devices** in the Navigation pane of NetVault Backup to display the Manage Devices screen.
Click the Manage Drive icon next to the displayed drive.



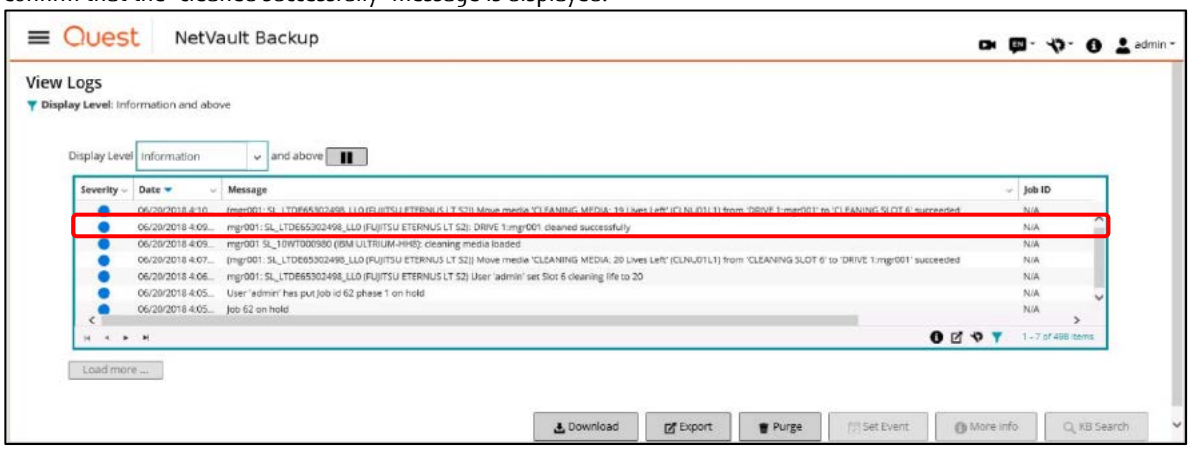
Click the **Drive Cleaning Options** button on the Tape Drive Management screen.



The **Drive Cleaning Options** dialog box appears.
Configure the cleaning options and then click the **OK** button.
The following is a setting example to perform a cleaning once everyday.



The result of the cleaning can be checked in the log.
Click **View Logs** in the Navigation pane to display the View Logs screen.
Confirm that the "cleaned successfully" message is displayed.



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