

A Brief Introduction to IBM Tivoli Storage Manager Disaster Recovery Manager

A Plain Language Guide to What You Need To Know To Get Started

By Sean O Sperry
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Introduction

IBM Tivoli Storage Manager (TSM) is a very flexible product that has a great depth of functionality. It supports many sophisticated means of disaster recovery preparedness including electronic vaulting of off-site DR data. Its core functionalities, however, are to support disaster recovery by producing off-site tape copies of backed up and archived data and to define the processes for recovering the TSM server in the event of its total loss.

The concepts and methodologies TSM uses to achieve this functionality are quite different than virtually all other backup applications. They were designed to provide maximum flexibility to the TSM Administrator, which, in turn, allows the product to be configured in many different ways. These different configurations result in a backup solution that can be configured to meet many solution requirements in terms of amount of data moved, ways to backup and restore files, cost of the equipment needed to perform the backup, and disaster recovery.

To the uninitiated, however, the terminology and constructs of a simple TSM Disaster Recovery implementation can be daunting. The purpose of this Field Guide is to provide a short, simple explanation of the concepts and methodologies that are necessary to implement basic TSM Disaster Recovery functionality using the TSM Disaster Recovery Manager. I will start with a few concepts necessary for TSM disaster recovery and continue with a basic configuration of the TSM Disaster Recovery Manager (DRM). I'll use the new TSM Administration Center version 5.3.2.0 to work with DRM.

This field guide is not intended to be a comprehensive tutorial on the TSM Disaster Recovery Manager or any kind of "best practices" guide. Its intention is simply to provide a starting point -- an answer to the question "How do I get the TSM DRM module going as quickly as possible?" At the end of the Field Guide, I will provide further information on the best resources for delving further into TSM functionality, planning, architecture, features, best practices, and disaster recovery.

TSM Disaster Recovery Concepts, Constructs, and Methodologies

Before an administrator can start implementing disaster recovery plans for TSM managed data, there are several concepts and constructs that must be understood.

The TSM Database

The TSM database is the heart of a TSM server; without the database, the server is dead! There is no way to restore TSM backups (except for client backup sets) without the database. Most administrators choose to keep 4-5 daily backups of the TSM database. If an administrator is doing off-site disaster recovery planning, he or she usually chooses to keep two sets of 4-5 daily backups of the TSM database; one set is kept on-site for immediate recovery while another is kept at an off-site location in case of total facility loss.

There are two types of database backups that are typically used for recovery; full database backups and snapshot backups. Full database backups are typically done on a daily basis after all copy storage pools have been updated and they are stored on-site.

Snapshot database backups are full database backups, but they do not reset the recovery log. Snapshot database backups are typically used for off-site disaster recovery purposes. They are made on a daily basis following production of a copy storage pool and are sent off-site with the rest of the daily tapes.

Device Configuration and Volume History

TSM stores information about volumes (e.g. tapes) it uses in its database. Specifically, when a database backup is made, a record is created in the TSM database containing the volume serial number of the tape used for the backup, the date, and the type of backup (e.g. full, snapshot, etc). Since there may be hundreds of tapes in a library, this information is needed in order to find the most recent backup.

There is, of course, a problem here. If an administrator loses the database, how can she look in the database to find the correct tape to restore it? The answer to this question is that TSM allows a flat text file called a volume history file to be created. This file contains information on all the volumes used by the TSM server, including the volumes used for database backup. The file is typically created on a daily basis after the database backup is made, and when restoring the database, the file can be used to find the tape that contains the appropriate database backup to restore.

Just like the volume history, TSM stores information on connected storage devices in its database. And just like volume information, an administrator will need to use those devices to restore the database in the event of its loss. The TSM server, thus, allows device information to be written to a text file called a device configuration file. This file is usually created daily and is read by the server when restoring the database from backup.

Copy Storage Pools

TSM backed up and archived data is stored on storage pools which are, by definition, collections of like media. TSM allows a storage pool to be duplicated to protect against loss or failure of media. This storage pool backup is called a copy storage pool.

It's important to understand how data is typically backed up to a TSM server in order to understand how critical copy storage pools are to TSM. Administrators typically use an "incremental forever" file backup methodology for file system backups with TSM, and when this methodology is used, a TSM storage pool will hold only one copy of any given file. If, for some reason (like a bad tape), the media on which the one copy is stored were to be lost, the only way to recover the data would be to use a copy storage pool.

I strongly recommend that there be at least one copy storage pool for all data that is stored on tape. The copy storage pool can be stored at a physical location which is separate from the primary storage pool (i.e. outside the tape library or off-site) for disaster recovery purposes.

Expiration for Off-Site Volumes in Copy Storage Pools

Data stored on off-site volumes can expire just as with data on any other volumes that are part of a TSM storage pool. Just like with normal expiration, when the data that is stored on an off-site volume expires, the entry for the data is deleted from the TSM database. The data is not, however, deleted from the volume; it just stays there until the tape goes to scratch and is overwritten. Of course, this does not happen until the volume is returned from off-site to the tape library.

Reclamation for Off-Site Volumes in Copy Storage Pools

A reclamation threshold can be set for off-site copy storage pool volumes just as it can for on-site primary volumes. But, since the tapes are stored in an off-site facility, the data cannot be copied from those tapes during reclamation. TSM deals with this issue by using on-site primary storage pool volumes to recreate the data. In other words, let's suppose an off-site copy storage pool volume falls below its reclamation threshold. Then the valid data is recreated in another copy pool volume which can subsequently be sent off-site. The redundant data, which is off-site, is expired and the off-site tape is returned to the on-site pool to be used as scratch.

The Disaster Recovery Manager (DRM)

The TSM Disaster Recovery Manager is a feature that is included with TSM Extended Edition and it is the part of the TSM application that can be used to assist with the management of off-site disaster recovery. Although you can manage off-site disaster recovery without the DRM module, it tends to make the process easier by doing two things. First, the DRM module can be used to track the movement of off-site media in the TSM database. And second, the DRM module can be used to consolidate plans, scripts, and information necessary for the recovery of the TSM server in a plan file. As we proceed through this field guide, we'll take advantage of the DRM module and commands to manage off-site copies of our storage pools and database.

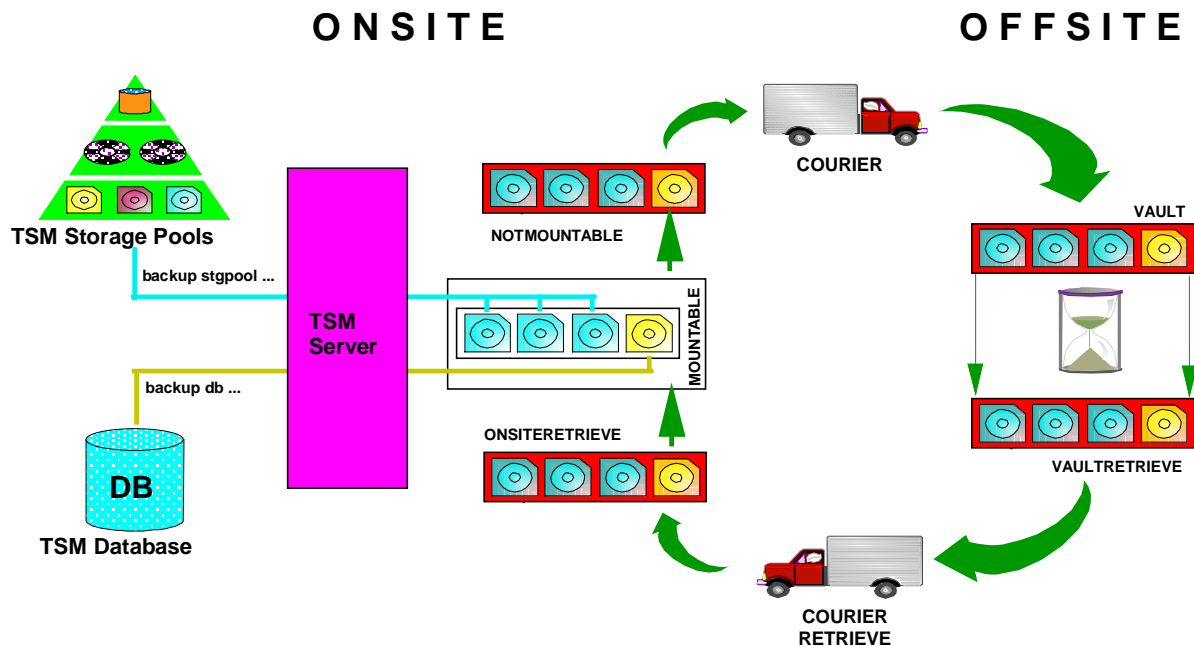
Site Specific Instructions for DRM

As mentioned above, the DRM module allows you to produce a DR Plan that includes site specific, plain text instructions for the disaster recovery. These instructions are entered in plain text files and stored on the TSM server. The following table describes each of those files and the intention of each.

File	Intention
RECOVERY.INSTRUCTIONS.GENERAL	Includes information such as administrator names, telephone numbers, and location of passwords.
RECOVERY.INSTRUCTIONS.OFFSITE	Includes information such as the offsite vault location, courier's name, and telephone numbers.
RECOVERY.INSTRUCTIONS.INSTALL	Includes information about server installation and the location of installation volumes.
RECOVERY.INSTRUCTIONS.DATABASE	Includes information about how to recover the database and about hardware space requirements.
RECOVERY.INSTRUCTIONS.STGPOOL	Includes information on primary storage pool recovery instructions.

The Life-Cycle of a Tape in DRM

As can be seen in the diagram below, the DRM module allows tape movement to be tracked through numerous locations. Many administrators, however, do not wish to track this amount of detail. On-site tapes necessary for DR typically move from the *Mountable* state directly to the *Vault* state. The DR Manager automatically moves tapes to the *Value Retrieve* when they are empty and ready to return on-site. The administrator then moves them from *Vault Retrieve* to *Onsite Retrieve* so that when they are checked into the library, they go directly to scratch.



A Summary of What You Need to Recover TSM

Recovering the TSM server and its data is the first step necessary in using TSM in a disaster where an entire site is lost.

The following table summarizes information that is necessary to recover the TSM server and its data in the event of total loss.

Item	Comment
TSM Server Operating System	Before a TSM server can be set up, the operating system and patches must be installed.
TSM Server Code and Patches	The TSM server code must be installed on the recovery system. Note that the exact same version and patch level should be used on the recovery system as was used to back up the database.
Device Drivers	Some libraries (usually IBM libraries) use device drivers that come with the library and are necessary with TSM.
TSM Server Database	The TSM database provides all the information necessary to find data on tape and restore it. Without the database, data in TSM storage pools is unusable.
Volume History	The volume history is a flat file used to find the database backup.
Device Configuration	The device configuration is a flat file used to access TSM devices when the server is not running.
dsmserve.opt	The TSM server configuration file sets all the options for the TSM server. It's useful to have this file so it does not have to be recreated.
"q sys" output	A query system command provides an overview of the TSM system. It's useful to have this output to see how TSM was configured before the system went down.
Copy Storage Pools	Copy storage pools contain the information from the primary pools that have been sent off-site.
DR Plan from DRM	The Disaster Recovery Plan from the DRM manager includes free form text for disaster recovery. It also contains information and scripts used to rebuild the TSM server.

The TSM Daily Schedule Including Disaster Recovery Manager Tasks

The Administration Center can create a Server Maintenance Script which will automatically run the typical administrative tasks for a server. Let's walk through setting up a maintenance script. From the TSM tree, I choose **Server Maintenance**. I choose my server and, from the action menu, I choose **Create Maintenance Script**.

I choose to perform all the maintenance in the plan, so I leave all the boxes checked in the select tasks dialog and click next (Figure 1). For the purposes of using a maintenance script, I'll choose to do only a database snapshot backup. So I choose this option and pick SUNCLASS in the backup server databases dialog (Figure 2).

I wish to backup my disk backup storage pool and my on-site tape pool to my copy pool DRPOOL, which I will take off-site every day. So on the backup storage pool dialog, I choose Add a relationship from the actions menu. I choose Backup Pool as the source and DRPOOL as the destination. I do the same for SUNPOOL (Figure 3).

Each Day, I wish to take the new DRPOOL volumes and my snapshot volumes off-site. I wish to send them directly to the vault. I choose this option and specify the UNTILL FULL for advanced library options (Figure 4).

I'm going to prepare a recovery plan on the existing TSM server, so I chose this option (Figure 5).

I then wish to migrate nightly backed up data from disk to tape. So I choose the BACKUP Pool to migrate (Figure 6).

I take the defaults for expiration and run reclamation for 300 minutes or down to 50% full for the sequential pool (Figure 7 and 8).

I want the maintenance schedule to run daily at 8:00 AM. So I make this selection and review the summary on the final wizard screen (Figure 9 and 10).

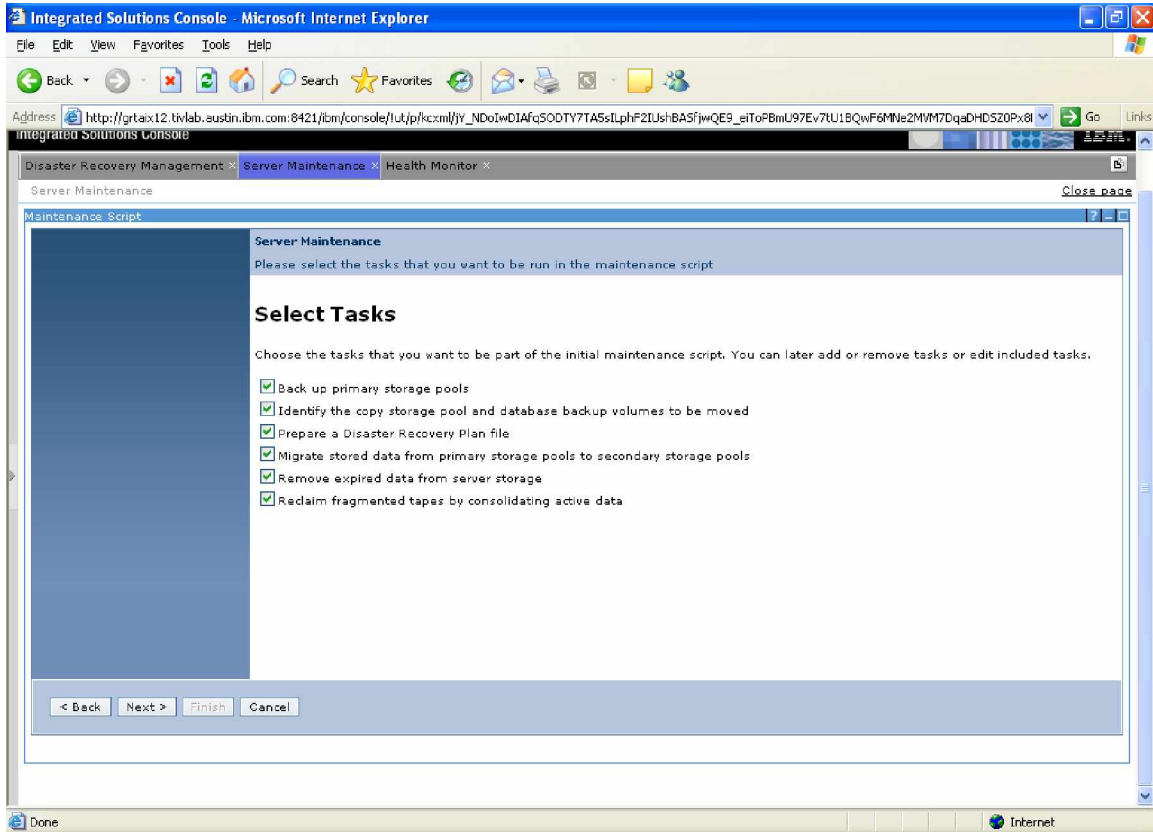


Figure 1

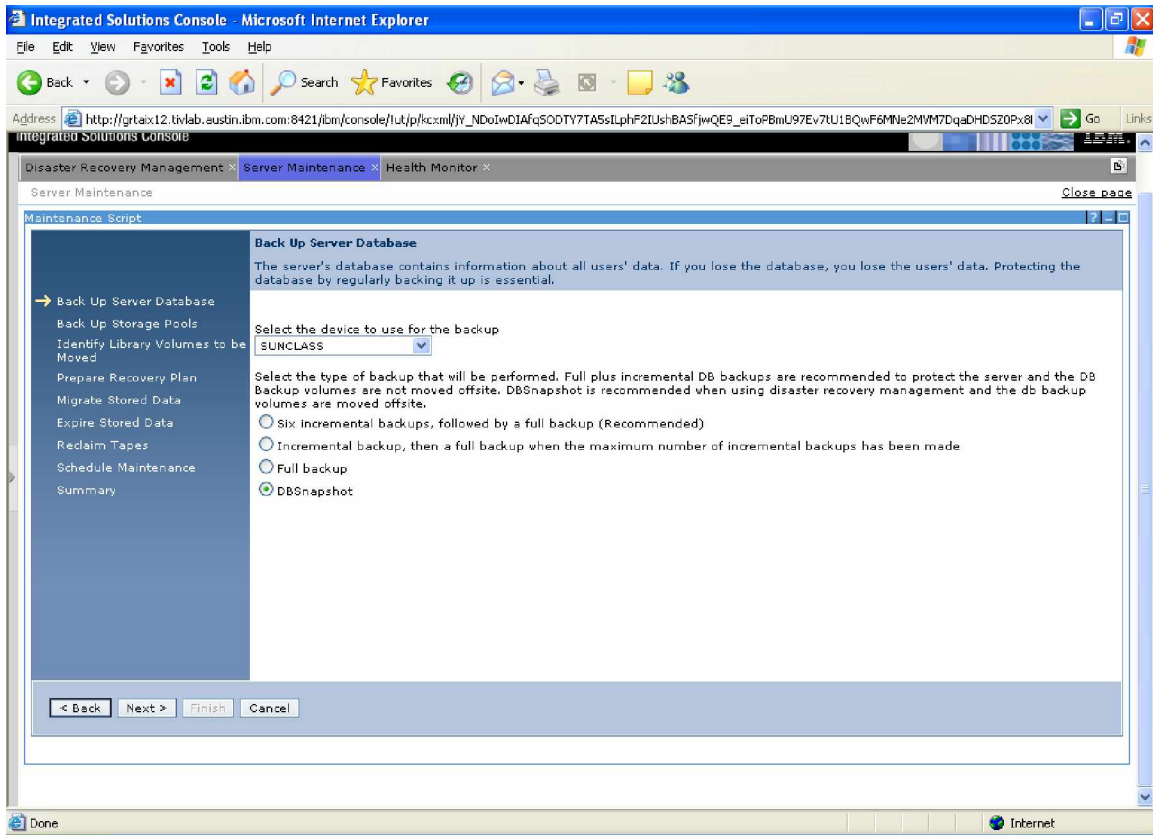


Figure 2

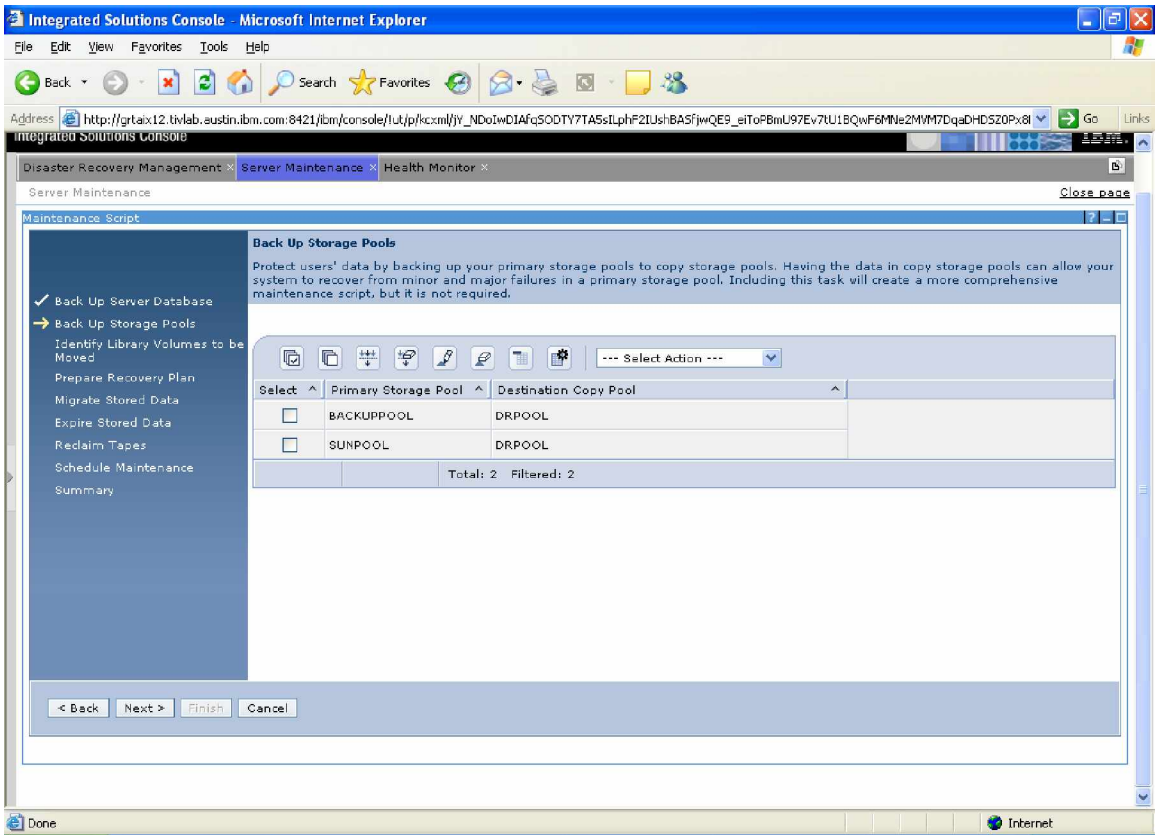


Figure 3

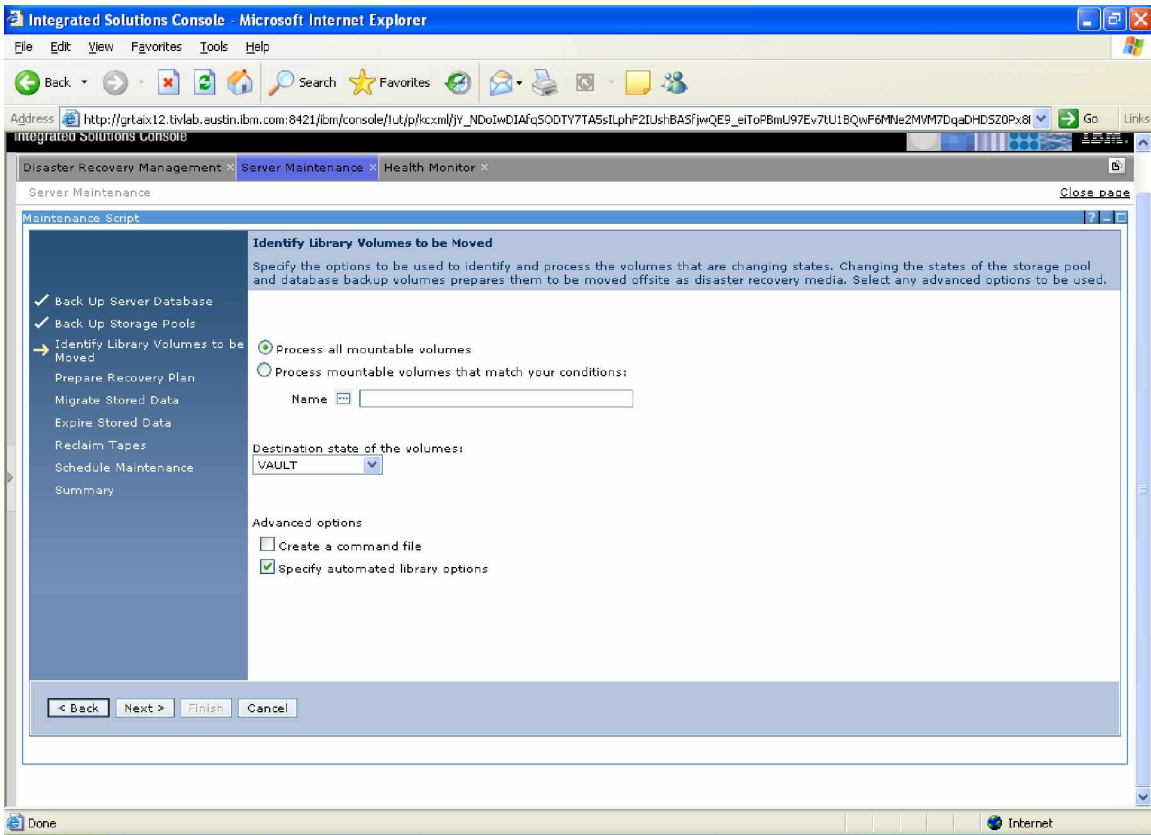


Figure 4

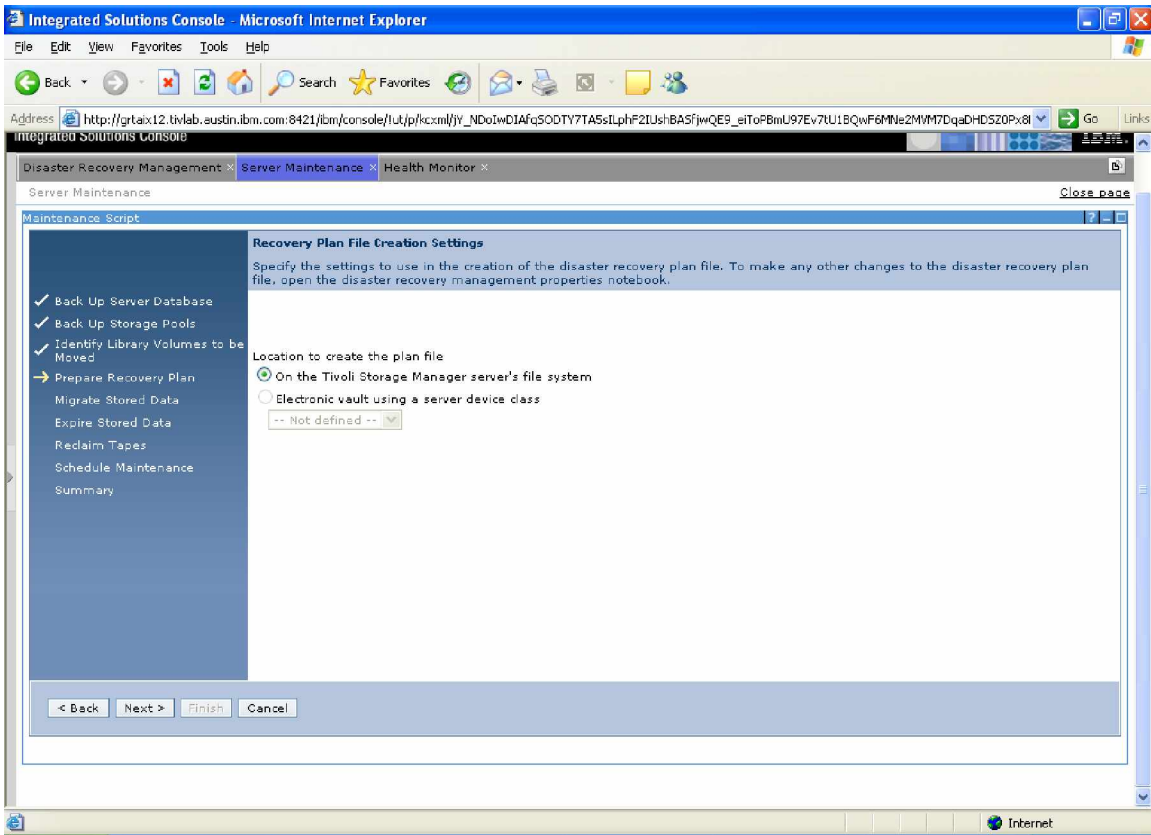


Figure 5

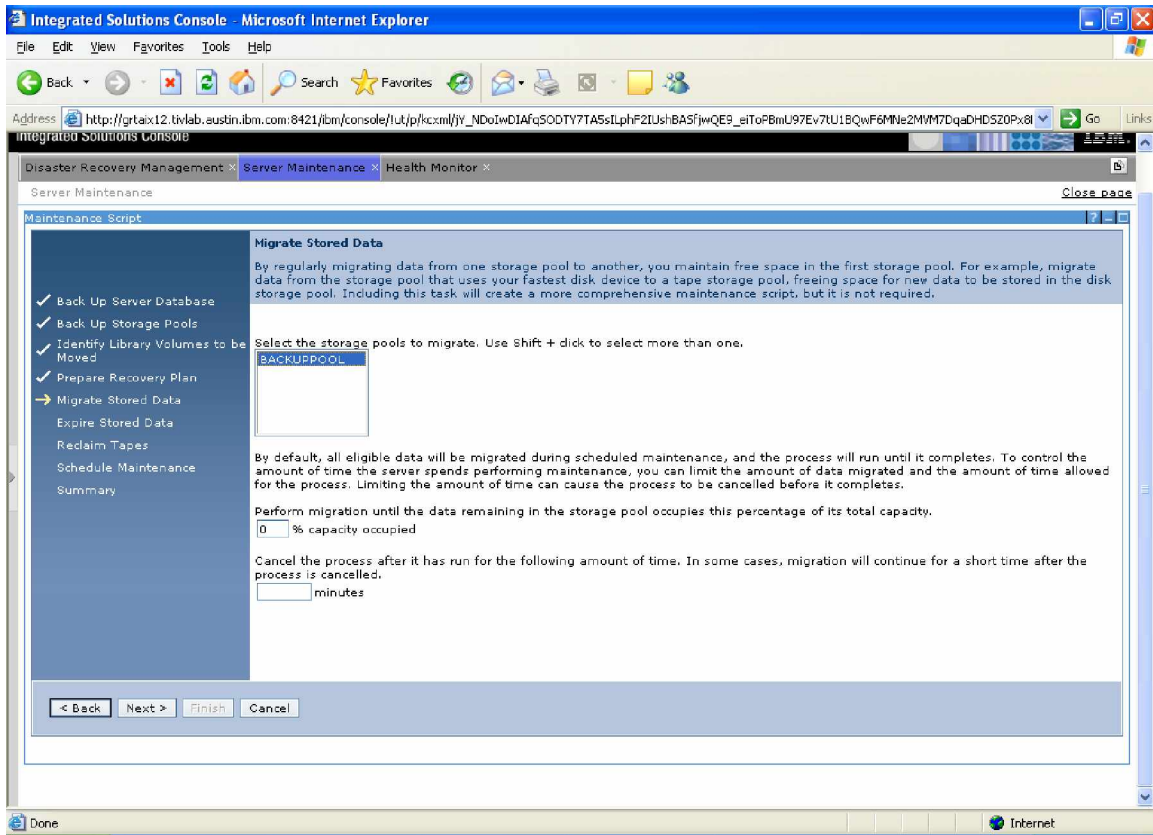


Figure 6

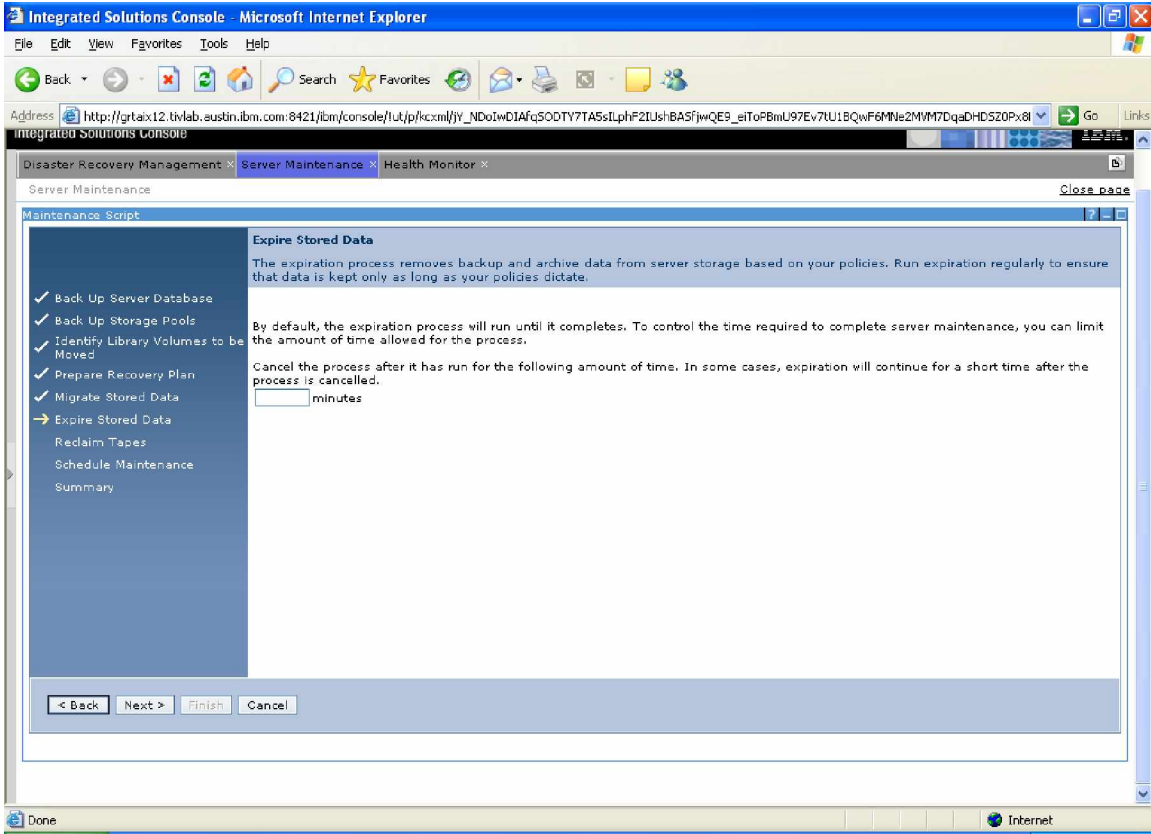


Figure 7

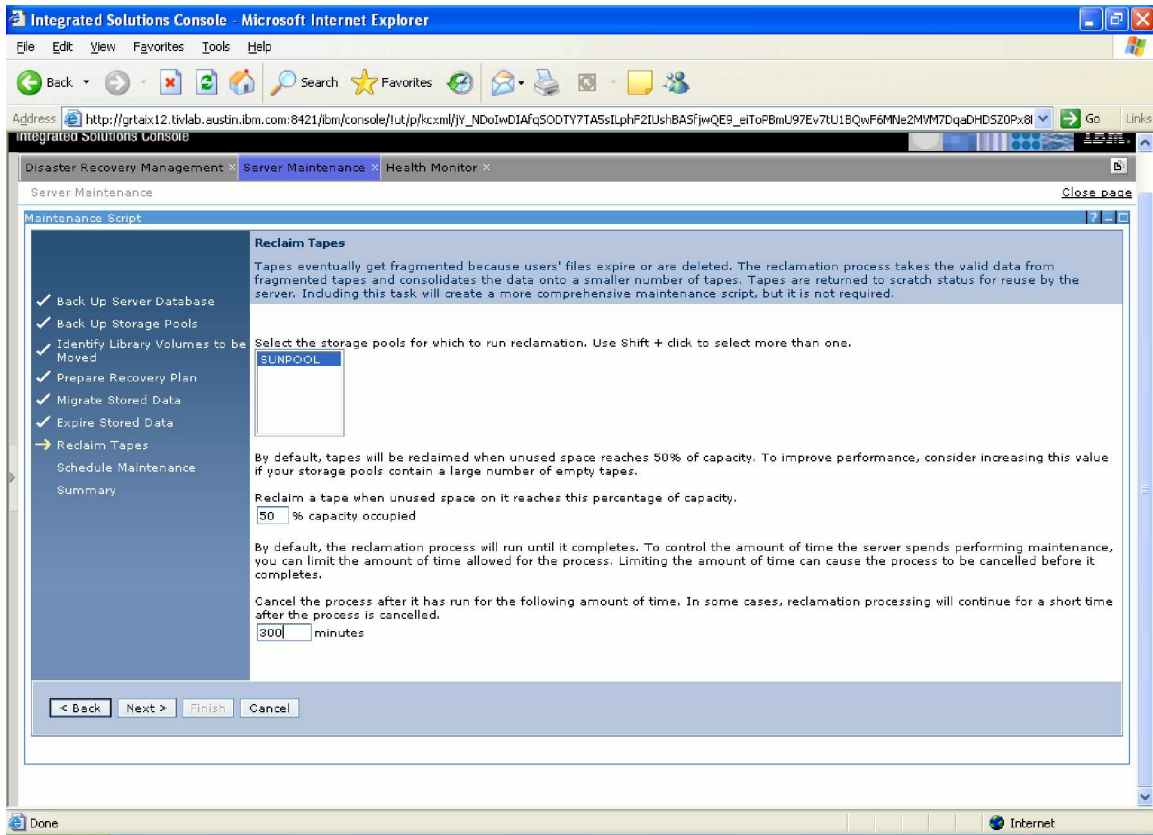


Figure 8

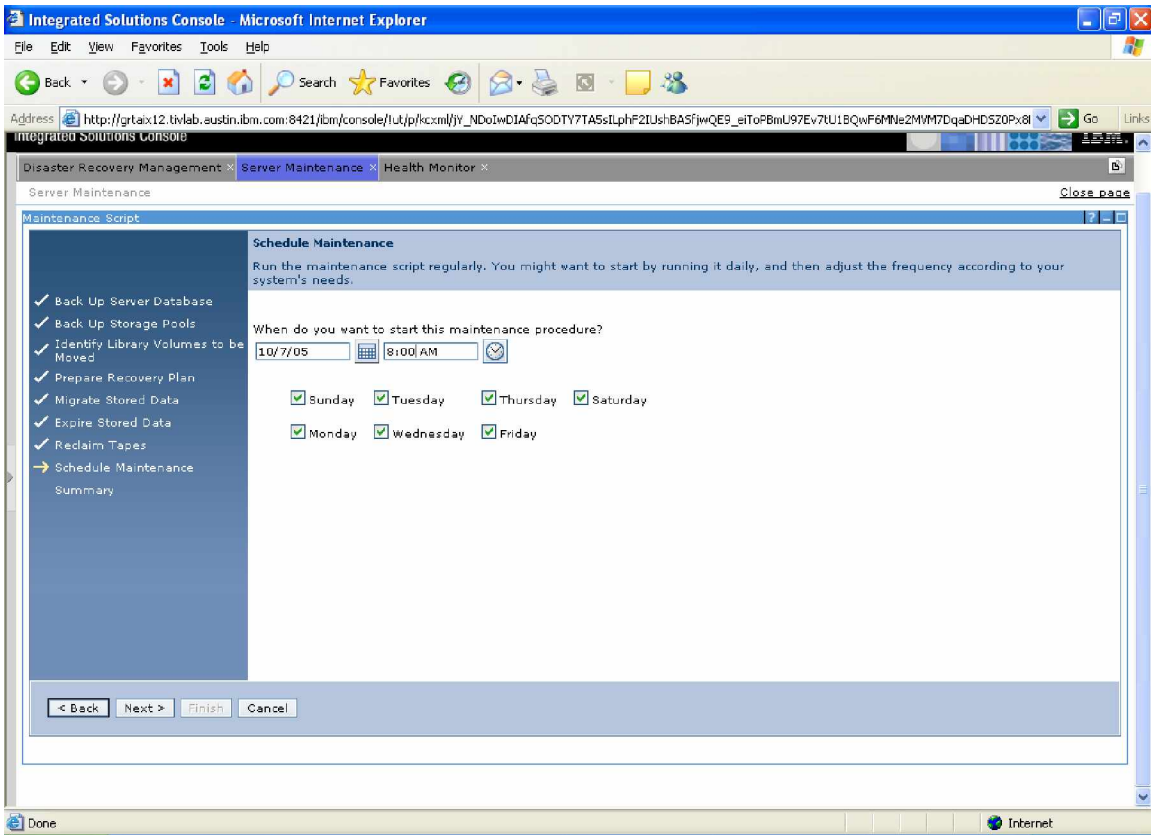


Figure 9

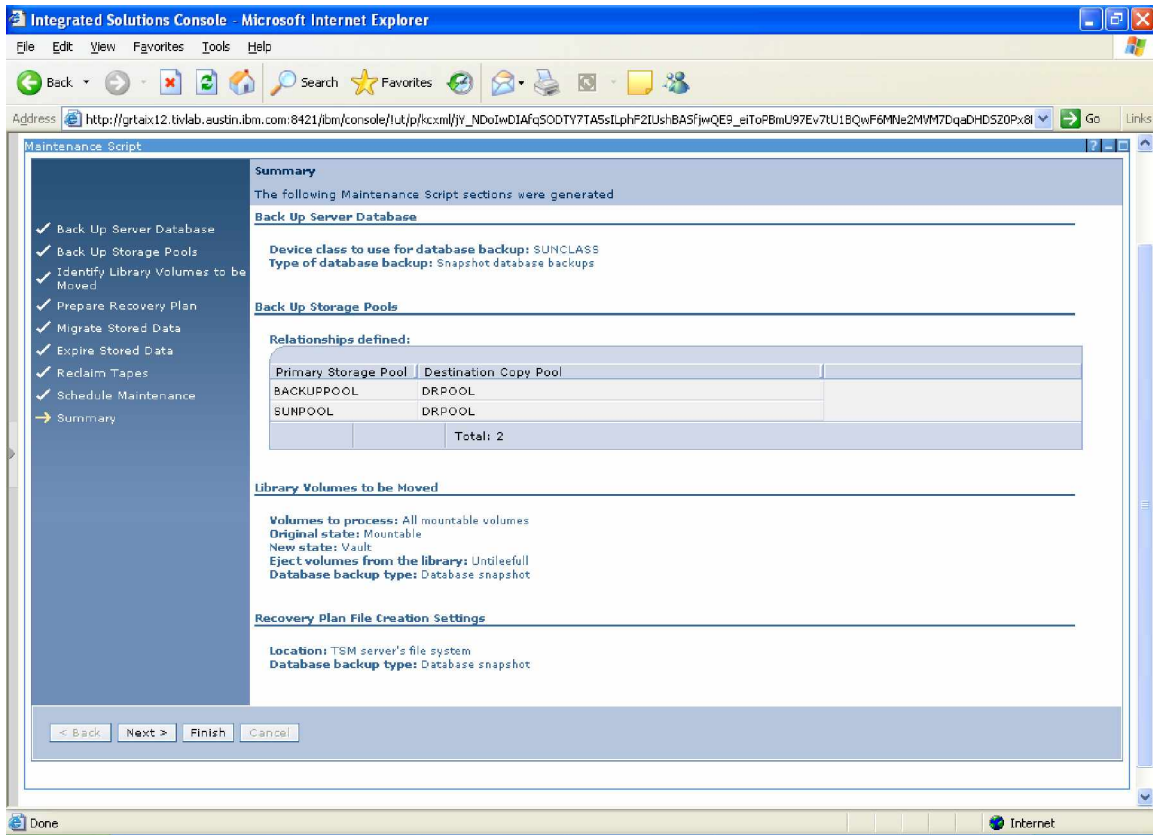


Figure 10

As an alternative to the Maintenance script, you can create your own schedule for maintenance on a TSM server. Many people want to implement more than the basic schedule provided by the Maintenance Wizard. I for example, typically keep a full DB backup on-site and a DB snapshot backup off-site. Below, I describe my typical schedule including DR activities and include the commands for setting these activities up in the step-by-step section of this Field Guide. Depending on the speed of your storage devices, there can be more efficient ways to set up the schedule such as migrating disk storage pool data directly to copy pool tape or using tape-to-tape copy.

Task	Time	Comments
Backups	Overnight	The nightly backups run. Usually they are sent to a disk storage pool which is sized to hold one nights incremental file system backup.
Migration	Morning	The disk storage pool is migrated to sequential access storage pool (tape).
Copy Storage Pool	Morning	The copy storage pool is updated to contain the latest backed up data.
Backup DB - Full	Morning	The TSM database is backed up to protect against loss.
Backup DB – Snapshot	Morning	The TSM Snapshot database backup to send off-site.
Backup Devconfig	Morning	Flat files holding TSM volume and device configuration is produced to aid in recovery in the event of the loss of

Task	Time	Comments
and Volhist		the database.
Prepare the DR Plan	Morning	The DR plan file contains information about how the TSM server is configured.
Off-Site Movement	Morning	The DR Plan, devconfig, volhist, and db backup are all sent off-site.
On-Site Movement	Afternoon	Off-site volumes that are empty are returned and checked into the library.
Expiration	Afternoon	Expire old objects in the server database based on policy.
Reclamation	Afternoon	Reclaim unused space that has become available on sequential access media (tapes).

For the off-site movement, the TSM database backup and copy storage pools will be in the form of tapes. The DR Plan, volhist, and devconfig need to be in a form that is easily readable and transferable; they can be stored on a floppy disk or sent in an e-mail. This should be sent off-site on a daily basis as well.

Basic Configuration of the DRM Module

Now that I have discussed some of the basic DRM concepts, I will go through setting up the DRM module and also do some tape movement exercises. Note that for these exercises, I'll be using version 5.3.2.0 of the TSM Administration Center. The Disaster Recovery Manager features are not available in the TSM Admin Center until this version.

Preparing the Copy Storage Pool

I need to create a copy storage pool that will be used for off-site storage. I choose **Storage Devices** from the tree menu and select my server in the Servers portlet. From the Actions menu, I choose **View Storage Pools**. I now see a portlet called Storage Pools for GRTSOL12 (my server). From the actions menu, I choose **Create a Storage Pool**. I define a copy storage pool called DRPOOL, choose Device Class SUNCLASS, set the maximum scratch to 9999 (an arbitrary large number), and set the Reclamation Threshold to 90% (See Figure 11-13 below).

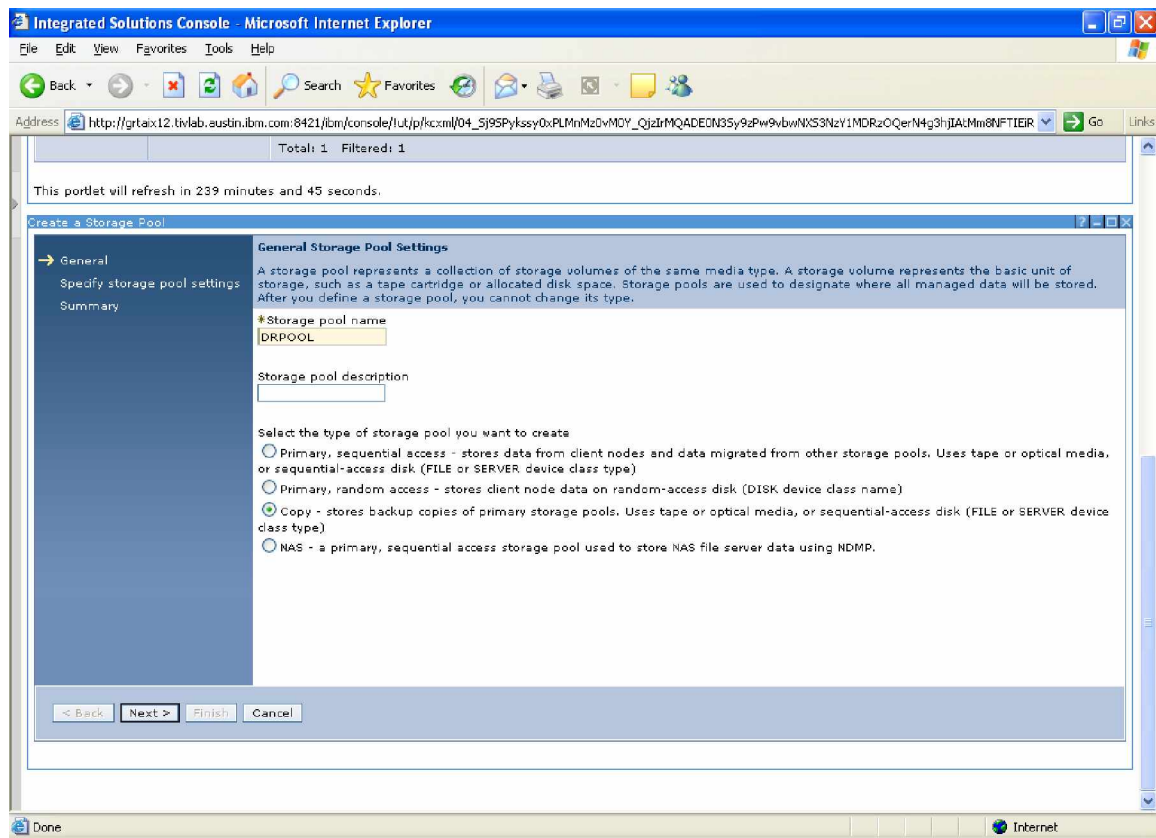


Figure 11

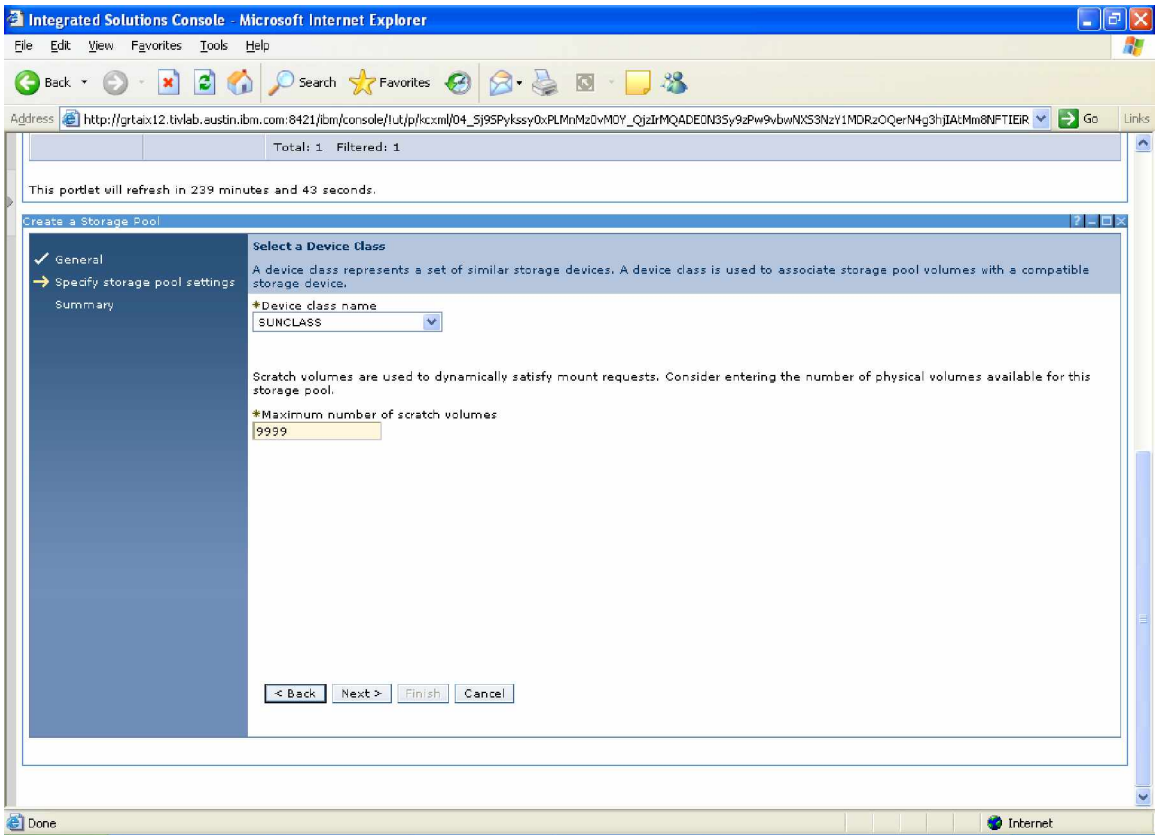


Figure 12

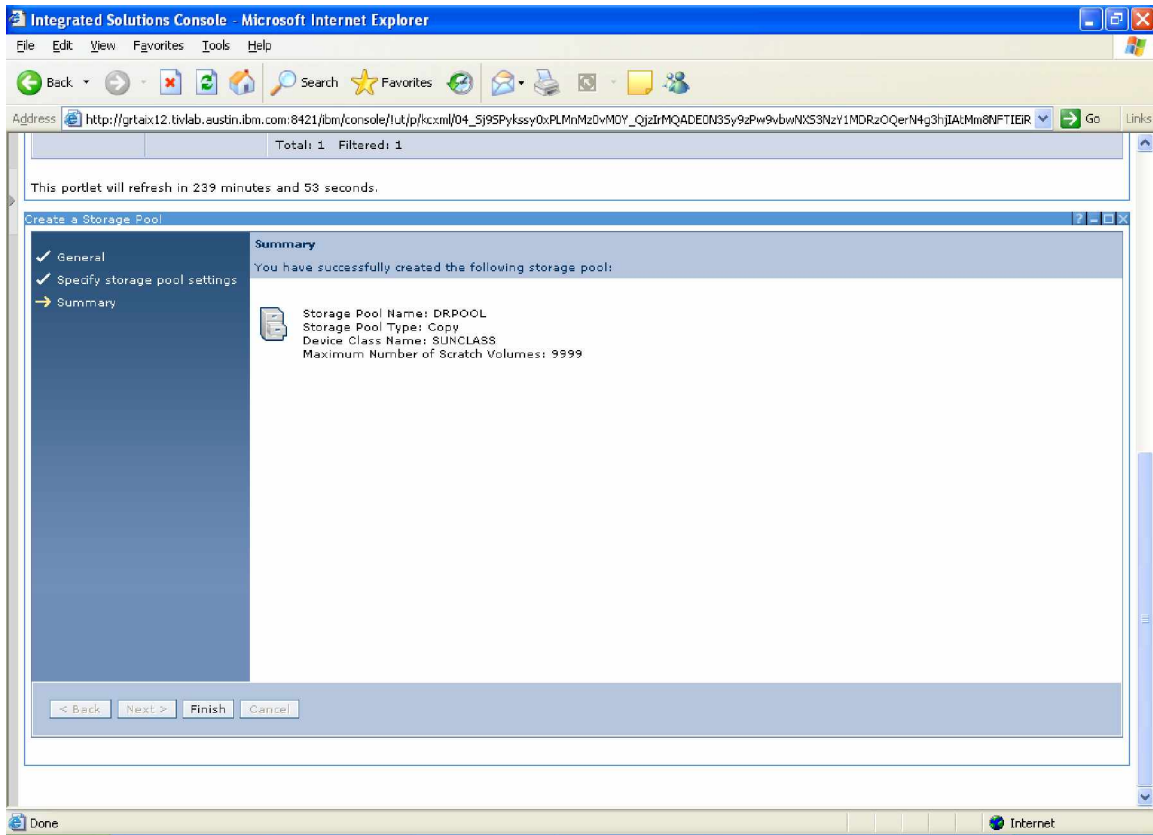


Figure 13

Next, I select SUNPOOL and go to the Storage Pool actions menu. I choose **Backup Storage Pool** and I then choose to backup my primary storage pool to the DRPOOL (figure 14 below).

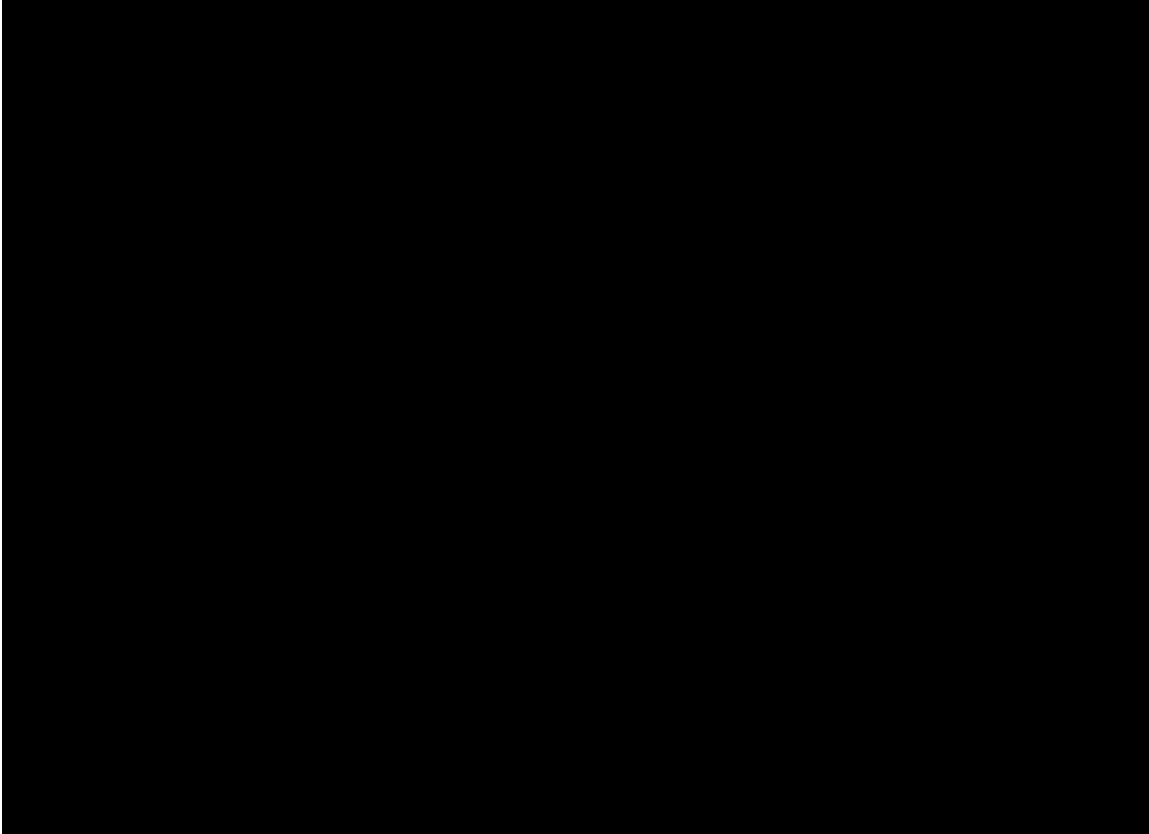


Figure 14

I can do a `query process` and a `query actlog` to determine when the copy storage pool is complete (note that this may take quite awhile depending on how many tapes are in the primary storage pool). After the copy pool is complete, I add the `backup stg SUNPOOL DRPOOL` command to the daily schedule or the maintenance plan.

Setting Up the Directories and the Recovery Instructions Files

I'm now ready to set up the directories I'll use to store the DRM Plan and the files that contain the DR instructions. I create two directories called `/opt/tivoli/tsm/planfiles` and `/opt/tivoli/tsm/recinst`. In the `recinst` directory, I create the plain text recovery instructions files (see Figure 15 below).


```

grrtsol12.tivlab.austin.ibm.com - PuTTY
root@grrtsol12:/opt/tivoli/tsm/recinst > ls
RECOVERY.INSTRUCTIONS.DATABASE  RECOVERY.INSTRUCTIONS.OFFSITE
RECOVERY.INSTRUCTIONS.GENERAL  RECOVERY.INSTRUCTIONS.STGPOOL
RECOVERY.INSTRUCTIONS.INSTALL
root@grrtsol12:/opt/tivoli/tsm/recinst > █

```

Figure 15

Setting Up the DRM Parameters

I'm not ready to set up DRM. I choose **Disaster Recovery Management** from the Tivoli Storage Manager Tree. After choosing my server, I choose **View Disaster Recovery Management Properties**. I then use the tabbed dialog box to set the parameters in the table below (see Figure 16 below).

Parameter	Value	Comment
DRM Plan Prefix	/opt/tivoli/tsm/planfiles/	The directory where I will store the DR plans.
DRM Instruction Prefix	/opt/tivoli/tsm/recinst/	The directory where I will store the plain text DR instructions.
DRM Primary Storage Pool	BACKUPPOOL, SUNPOOL	These are the primary storage pools that will need to be recovered for DR.
DRM Copy Storage Pool	DRPOOL	These are the copy storage pools to send off-site for DR.
DRM DB Expire Days	7	The number of days to keep off-site database backups?
DRM Recovery Plan Expire Days	7	The number of days to keep the recovery plan.

I take the defaults for the rest of the parameters.

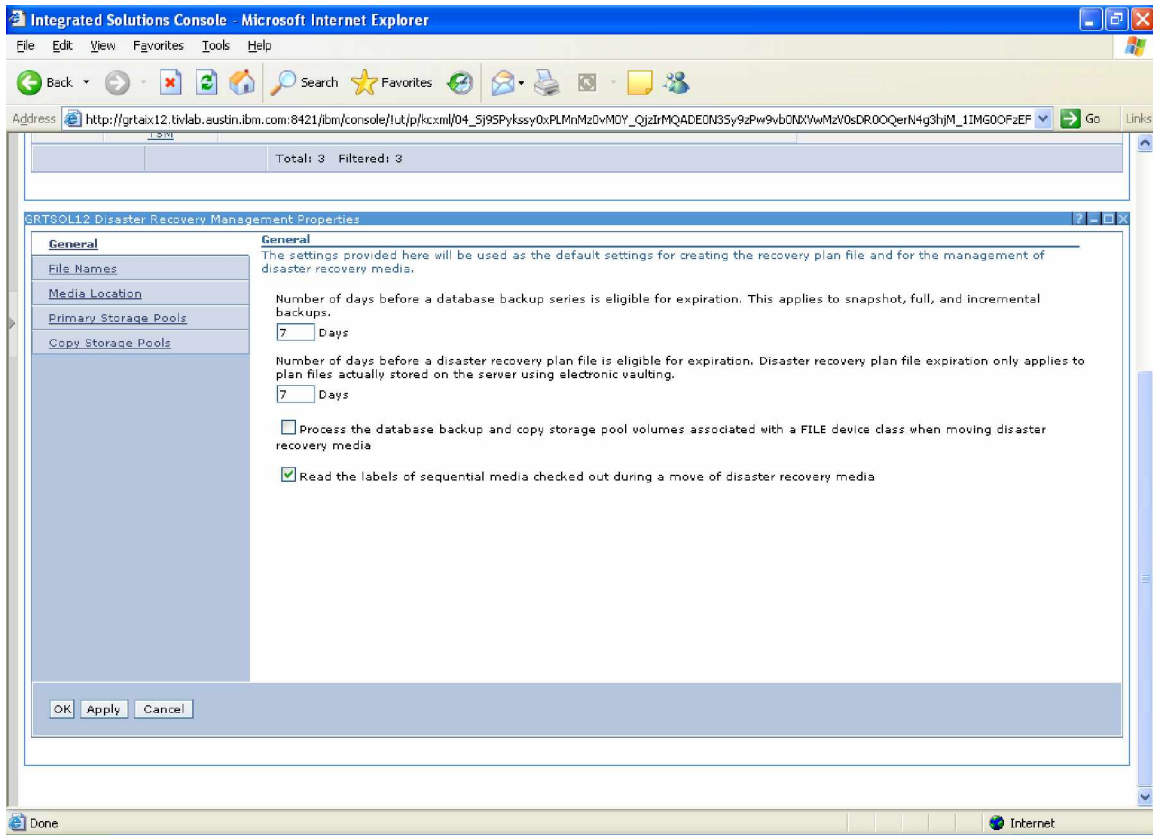


Figure 16

Database Snapshot Backup

I'm now ready to do a database snapshot backup. From the Tivoli Storage Manager tree, I choose **Enterprise Management**. Then I select my server from the list and choose **Server Properties** from the Action Menu. From the server properties dialog, I then choose the **Database and Log** tab. From the Database section, choose backup **Backup** from the actions menu. I select the snapshot database backup, chose my device class, and allow use of scratch volumes. and choose snapshot (see Figure 17 below).

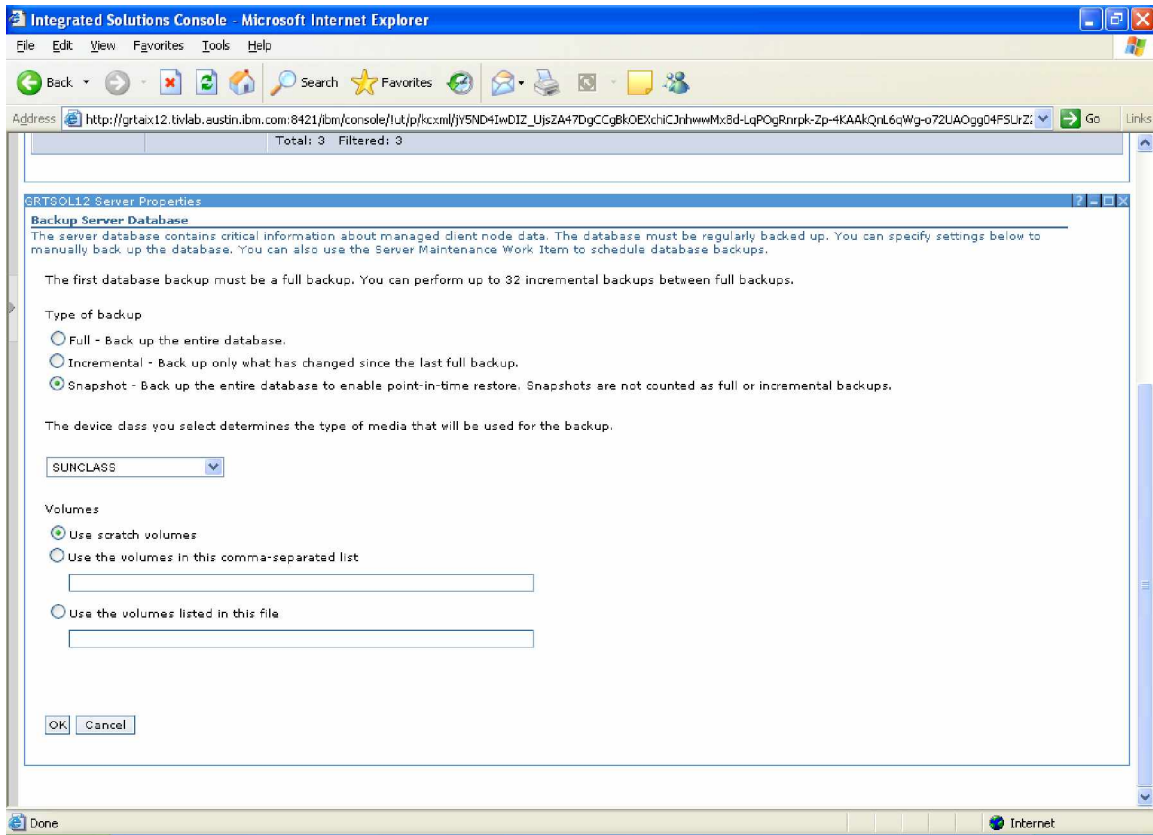


Figure 17

I can do a query process and a query actlog to determine when the database backup is complete. I add the backup db DEV=SUNPOOL TYPE=DBS command to the daily schedule.

Moving DR Volumes Off-site

Now I can move my first set of DR volumes off-site. From the TSM tree, I choose **Disaster Recovery Manager**. I choose my server and from the Action menu, I chose **Move Disaster Recovery Media**. I wish to move all my mountable DRM media off-site to the vault and eject them from the library. So I choose to view volumes that are mountable and include snapshot database backups. Then I click the Update Table button. As can be seen, I have 2 volumes that need to be sent off-site (see Figure 18).

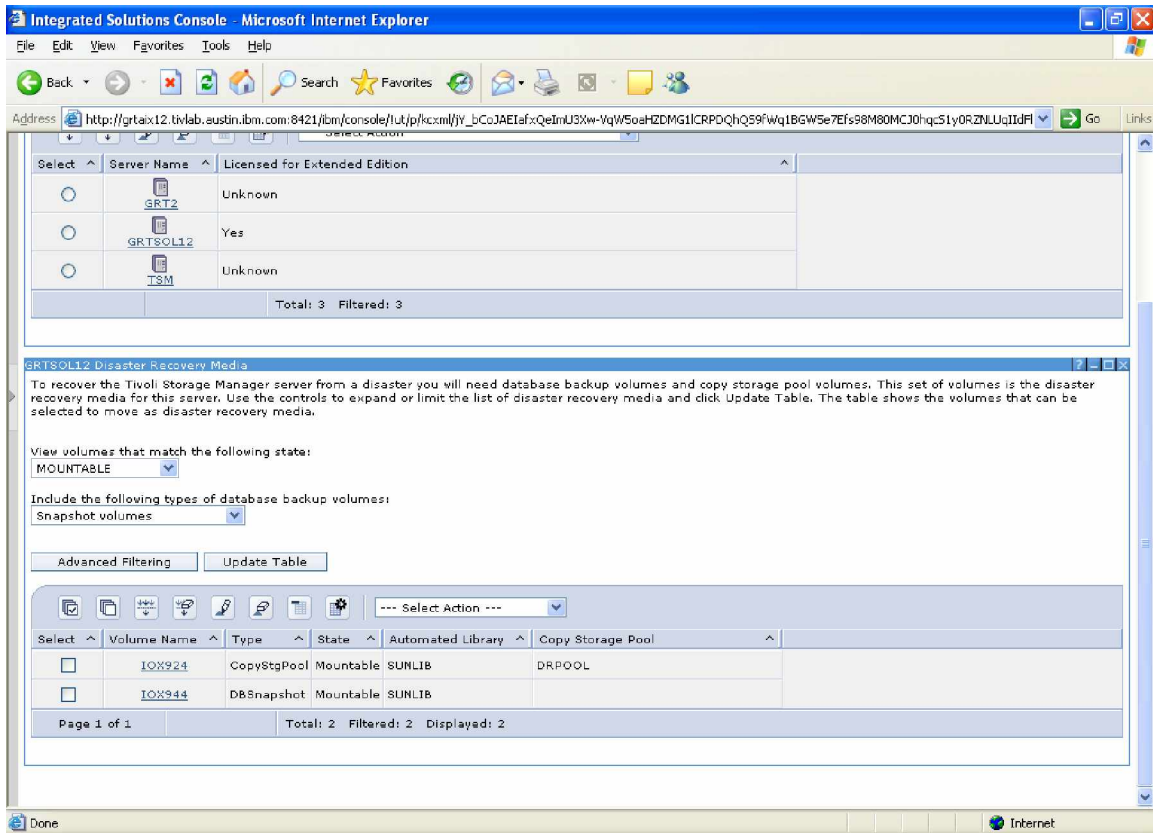


Figure 18

I wish to move the volumes to the vault. So I choose the select all button and from the Action Menu, I choose Move Selected Volumes. In the wizard, I choose to send them directly to the VALUT state and check the checkbox to specify how the values are ejected (see Figure 19 below). On the advanced options dialog, I set the remove media value to UNTILFULL (see Figure 20 below). The DR media is ejected from the library. For my Library, I get one process for each volume. When completed, I can see the tapes stored in the vault by issuing the `q drmedia wherestate=vault` command or using the **View Disaster Recovery Media** action item and choosing Vault as the state and Snapshot Backup as the backup type (see Figure 21). I add the `move demedia * wherestate=mountable source=dbsnapshot remove=untillfull tostate=vault` command to the daily schedule.

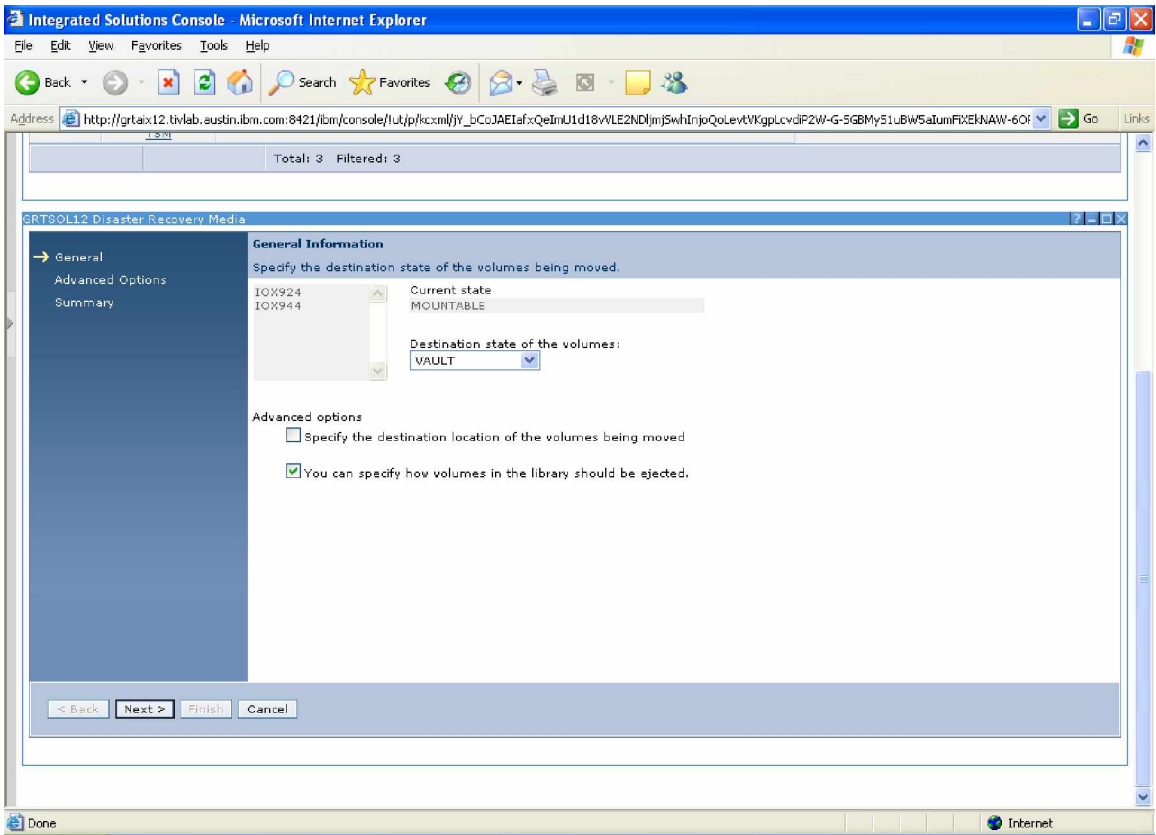


Figure 19

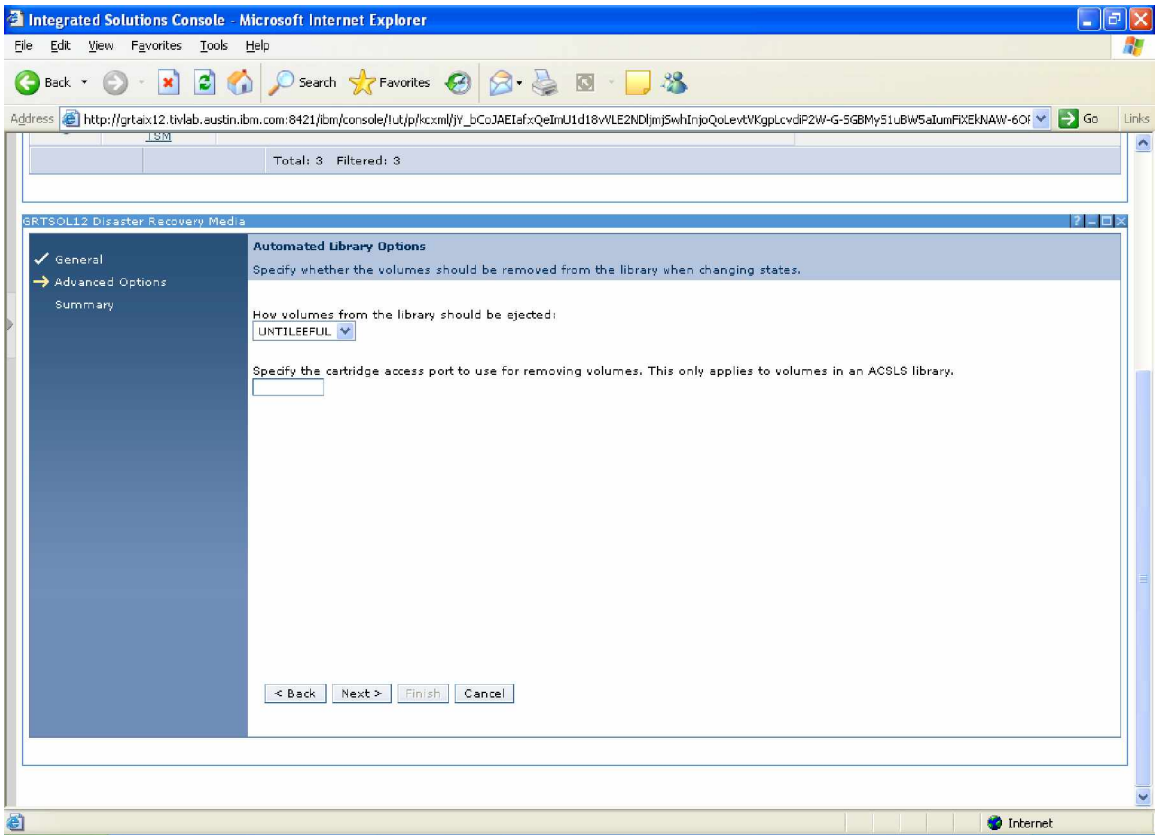


Figure 20

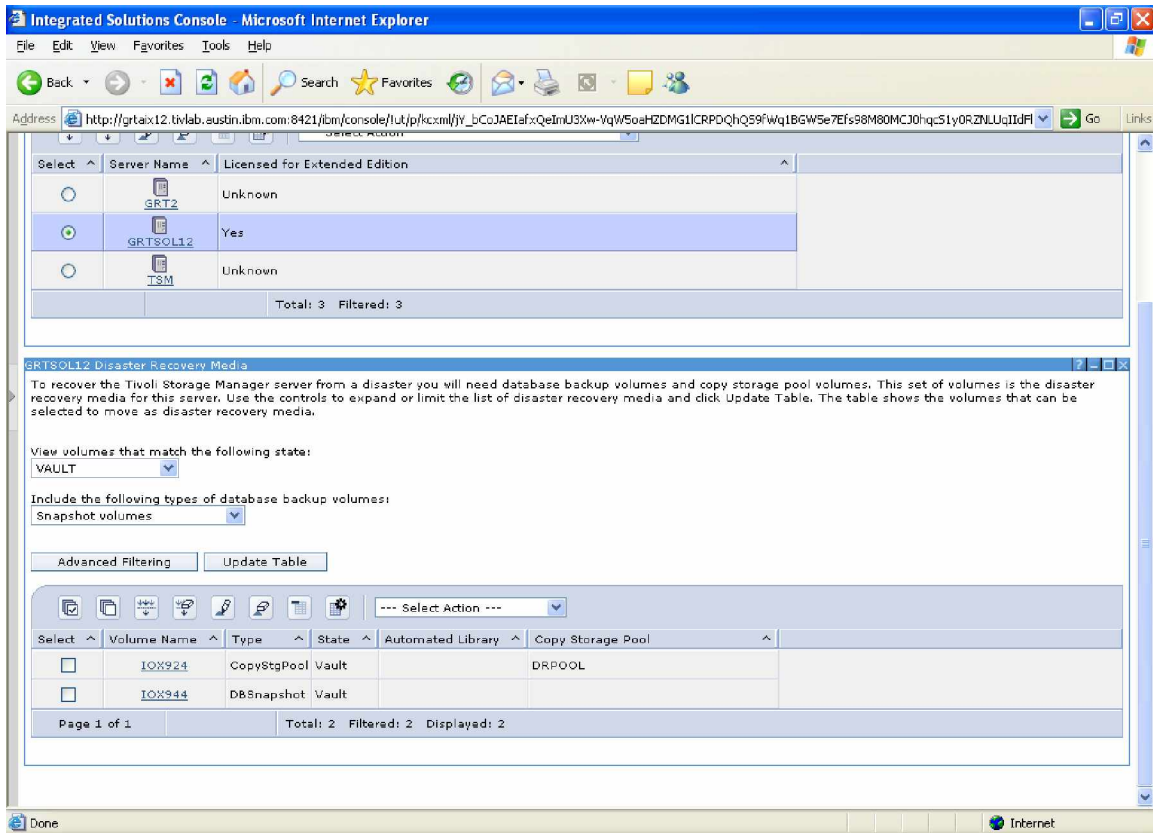


Figure 21

Creating the DR plan, volhist, devconfig, and q sys

I need to create a DR Plan, volhist, devconfig, and q sys files on a daily basis. I add the prepare, backup volhist, backup devconfig, and q sys > <filename> commands to the daily schedule. The files produced by these commands need to be sent off-site in electronic format using a script or some other means. Note that technically, the DR plan file contains all the information in the other files. When it comes to DR, I just choose to be careful and have redundant information.

Moving Empty DR Volumes On-Site

As time passes, off-site data will expire and off-site database backups will be replaced by more recent database backups. I need to recall tapes from off-site that are empty or no longer needed. Tapes that need to be recalled and returned to the library are in the vault retrieve state. I can get this list by choosing **Disaster Recovery Manager** from the TSM tree and then choosing **View Disaster Recovery Media**. Volumes ready to return onsite fall to the Value Retrieve state. So I choose VALUTRETRIEVE, Snapshot Volumes, and Update Table. (see Figure 22 below).

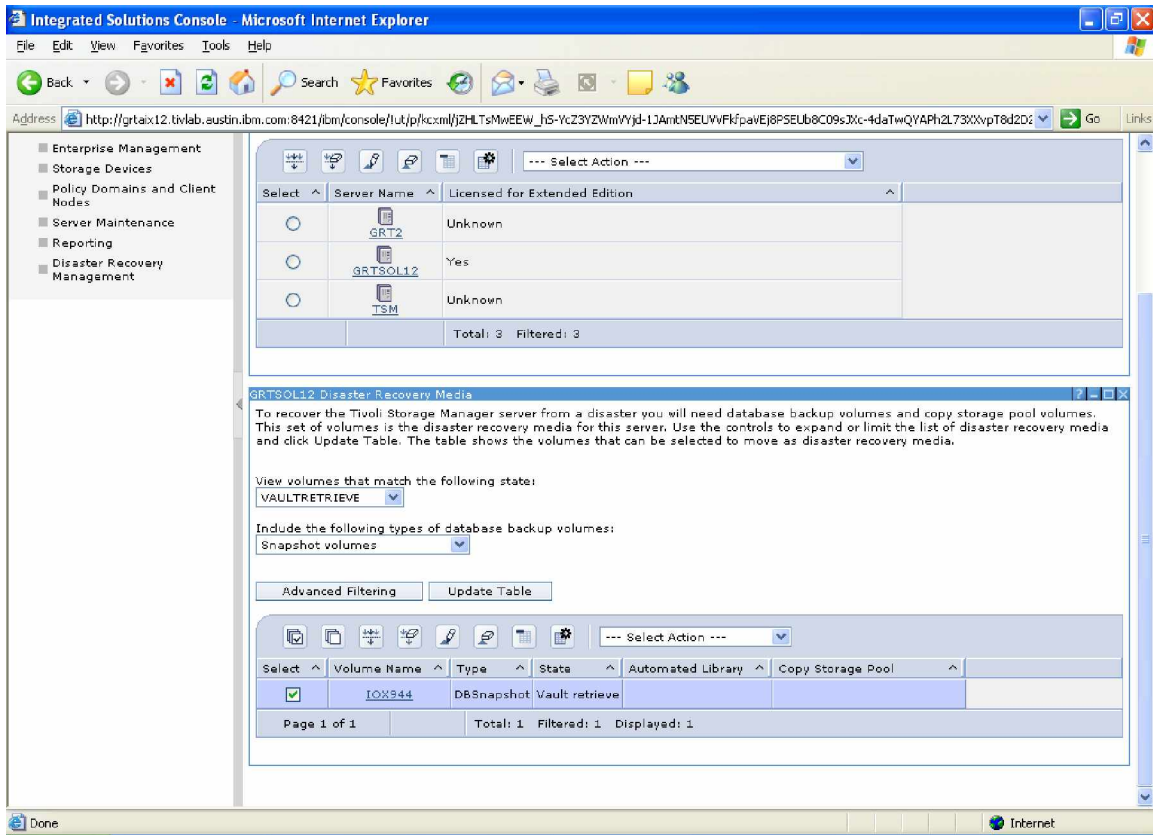


Figure 22

As you can see from the screenshot, in my case, I have one tape that needs to be returned on-site (this happens to be a database backup). I will use the web GUI to return the tape from its Vault Retrieve status to Onsite Retrieve and then check it back into the library as a scratch tape.

I select the volume and from the actions menu choose Move Volumes from the Actions Menu. I choose ONSITERETRIIVE for the destination state of the volumes.

Once they are in the library, I also want to create a command file to check them in. So I choose view Disaster Recovery Media in the Onsite Retrieve state and select Create a Command File to create a macro to check in the returned tape. I add a command to the wizard for each volume by setting the command to `checkin libv &vol status=scratch` and setting the file to put the commands in to `/opt/tivoli/tsm/macros/checkin` (see Figure 23 below). After running the command, I can check the scratch tape into the library using the command file I create.

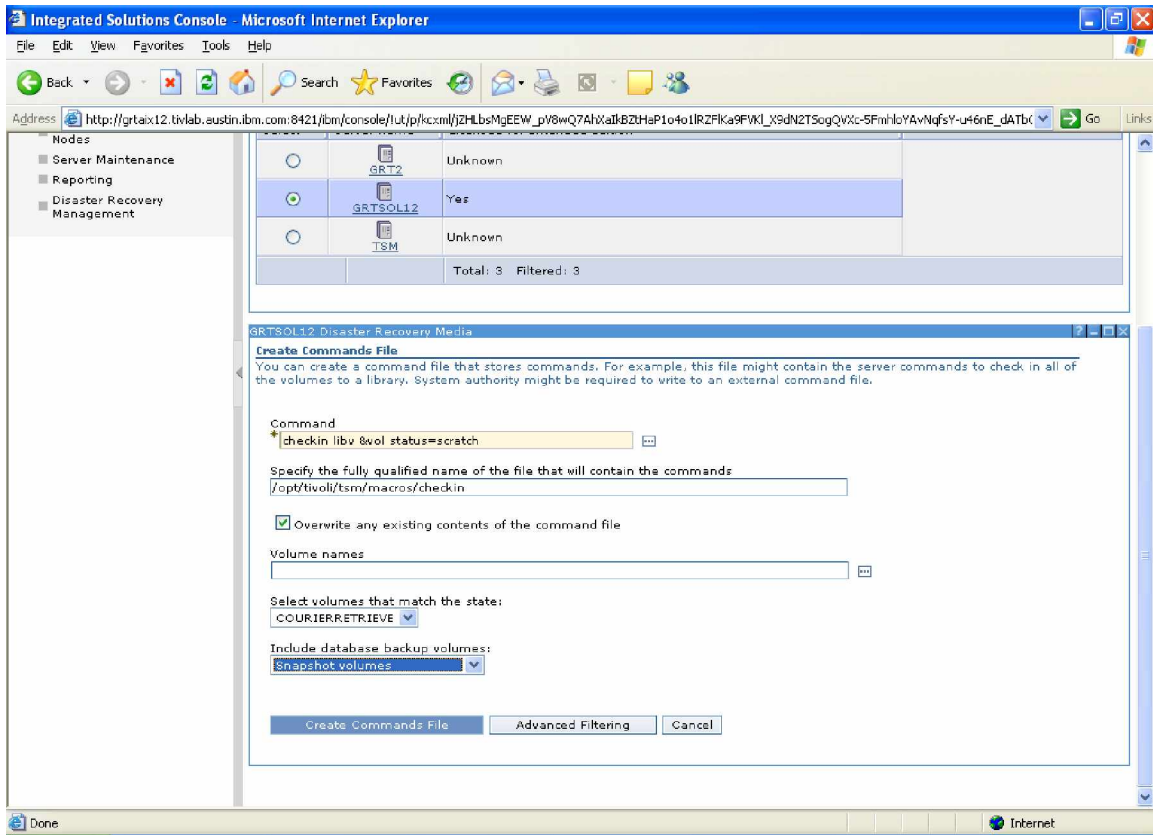


Figure 23

In terms of scheduling, a list of tapes to be returned needs to be generated on a daily basis. Typically, these tapes do not actually get returned until the next day and are checked in at that time. So I add the `query drmedia` to generate the list and then move `drmedia` to my daily schedule. I also add the `checkin` to the daily schedule for the previous day's tapes.

Best Practice Recommendations and Additional Resources

Conclusions and Best Practices

Although setting up the DRM module in TSM is quite easy, setting up the processes and procedures used for TSM sever recovery and tape movement can be quite difficult and time consuming.

First, it is highly recommended that step-by-step instructions be written for setting up the DR hardware, installing the host OS, installing TSM, restoring the TSM database, and updating the TSM storage pools. During a disaster, even an experienced TSM administrator will be under extreme pressure to restore the TSM server as soon as possible, and having a step-by-step guide for your particular environment can greatly improve TSM server recovery time.

Second, it's very important to test the DR plan and TSM server recoverability often and in an environment that is as realistic as possible. At almost every test, you will undoubtedly encounter hurdles that you didn't expect. Testing allows an administrator to develop confidence and experience. It also allows detailed plans to be verified and modified so that they are more likely to be accurate in the event of a real disaster.

Finally, it should be understood that the success or failure of a DR plan hinges on the availability and accurate movement of the off-site tapes. It is very typical for TSM administrators to assign tape movement activities to operations staff who may not be experienced or who may not have a high interest in ensuring the success of the DR operation. Tape handling problems and errors are the largest cause of DR preparedness issues.

A TSM administrator should take extra precautions to ensure that tapes are not lost in the rotation. Tape movement processes usually include scripting to ensure that electronic updates are accurate and errors are dealt with correctly. Sometimes, tapes are scanned and tracked externally to make sure they are not lost, and these reports are reconciled with the TSM database daily.

Additional Resources

Web Sites

Manuals

<http://publib.boulder.ibm.com/tividd/td/tdprodlst.html>

This is the home page for all Tivoli Manuals. Chose "S" for Storage Manager. The TSM Administrator Guide and Administrator Reference for the platform of your TSM server contain information on the DRM module of TSM and the recovery steps for the TSM server.

Training Overview

IBM Tivoli Disaster Recovery Manager 5.3

<http://www-306.ibm.com/software/tivoli/education/A766698B86554B97.html>

This course covers using the TSM DRM module to automate the process of doing off-site media storage and recovering from the loss of a TSM Server. In addition to off-site media rotation, electronic vaulting is also discussed.

Redbook Overview

IBM Redbooks are great (and one of the only) sources of information on IBM software and hardware. Due to its maturity, there are numerous good Redbooks covering TSM. Below I have provided the ones I found most useful for TSM DR.

Disaster Recovery Strategies with Tivoli Storage Manager

<http://publib-b.boulder.ibm.com/Redbooks.nsf/9445fa5b416f6e32852569ae006bb65f/e679138e56505a0d85256c6a00634b42?OpenDocument>

This Redbook provides details on DR scenarios. This redbook starts with a description of the DR process and planning. It then applies these concepts to recovering the TSM server and clients. Bare Metal Restore of various operating systems is discussed including AIX, Solaris, Win2k, and Linux.

Bare Machine Recovery for Microsoft Windows 2003 and Windows XP

<http://publib-b.boulder.ibm.com/Redbooks.nsf/9445fa5b416f6e32852569ae006bb65f/6b5c6c470a02479385256d3c005d48ff?OpenDocument>

This Redpiece describes using TSM with Windows ASR for Windows 2003 to do a Bare Machine Recovery.