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IBM® TS7700 Series
Copy Export Function User's Guide
Version 2.7

Kerri Shotwell
Takahiro Tsuda

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Introduction

The IBM TS7700 Series is the latest in the line of tape virtualization products that has revolutionized the way mainframe customers utilize their tape resources. One of the key reasons to use tape is for recovery of critical operations in the event of a disaster. The TS7700, in a Grid configuration, provides for automatic, remote replication of data that supports recovery time and recovery point objectives measured in seconds. For customers that do not require the recovery times that can be obtained in a Grid configuration, a new function called Copy Export is being introduced for the TS7700. With Copy Export, logical volumes written to a TS7700 can be removed from the TS7700 and taken to an offsite location to be used for disaster recovery. This white paper describes the use of this function.

It is assumed throughout this white paper that the reader is familiar with the TS7700 and in using standard labeled tape volumes and MVS tape utilities.

Summary of Changes

- Version 1.1
  - A descriptive header line was added to the copy exported physical volume information returned in the export list status file.
  - Clarified the requirement for scratch physical volumes during the execution of a copy export operation.
  - Added dual LM operational requirements during copy export recovery.
  - Clarified how copy export recovery deals with the discovery of duplicate volumes on the second library manager partition.
  - Added a note describing a scenario where a logical volume that is only cache resident may not be eligible for a copy export operation because it was removed from the premigration queue when it was remounted after being created.
- Version 1.2
  - Added the starting and ending logical block ID where a logical volume resides on a copy exported tape to the export status file record.
  - Added instructions for when to add scratch physical volumes during a copy export recovery operation.
  - Clarified the actions necessary if duplicate logical volumes are encountered during copy export recovery.
  - To avoid confusion about using the copy export recovery for testing disaster recovery, the check box, ‘Disable premigration on construct change’ has been changed to ‘Disaster Recovery Test Mode’ and the text descriptions clarified to better explain what impact this has on the operation of the TS7700.
  - When to verify or change storage management construct actions has been moved until after the recovery process has been completed to simplify this step.
  - When the physical volumes to be used for copy export recovery are added to the library, they are no longer placed into the Unassigned Volume category. They are directly moved into the insert category.
  - Added to the copy export recovery considerations section an item regarding how storage construct names and definitions are recovered to the library manager database and the effect that can have if the same storage construct names are already defined on another library partition.
- Version 1.3

  - Updates to the section describing reclamation of offsite copy exported volume have been made to add the timing considerations for host console requested reclaims and for messages related to those reclaims.
  - The descriptions for 'MB written when full" and "Percent Utilized" fields in the export status file for physical export volumes has been clarified to indicate that they are rounded up to the nearest unit.
  - Adds a description of how a copy exported volume is handled if the I/O station is full and the 'Eject' option has been specified.
  - Adds an additional item in the copy export considerations section about the I/O station.
- Version 1.4
  - New export status codes have been added to cover how the change in how a recall failure on a primary pool volume causes the logical volume on the secondary volume to become the sole accessible copy of the volume.
  - The case where the I/O station is full and the 'Eject' option is specified is handled differently after this version level.
  - For code levels of 8.5.x.x or higher, the library manager function has been integrated into the TS7700.
- Version 1.5
  - Add E06 as a valid recording format
- Version 1.6
  - Clarify need for physical scratch on recovery machine regardless of whether running in test mode or doing an actual recovery
- Version 1.6.1
  - Change the limit of the number of copy exported physical volumes per TS7700
  - Clarify copy export behavior
- Version 1.7
  - Add reference to new process available to use copy export tapes to recover a node within a grid.
  - Tapes that are physically in the library in the copy export hold state and go empty are available for read/write.
  - Increase the minimum number of scratch volumes required for copy export recovery.
- Version 2.0
  - Introduction of E07 drives and JK/JC media.
  - Customers that have E07 drives can choose to write copy export physical volumes in either 3592 E06 or E07 recording format.
  - Clarify requirements for feature code 5270 on the DR machine
  - Add pre-cautions of modifying the reclaim pool for a pool designated as a copy export pool.
  - Modified the setting of maximum filling devices when setting up pools.
- Version 2.1
  - Introduction of copy export acceleration which reduces the number of export tapes containing a database backup
  - Introduction of copy export merge as a service offering. An enhancement of the current copy export all function allowing the data to be restored into an existing TS7740.
  - Copy export hold volumes can be moved back into the source TS7700 without ejecting them first.

- Version 2.3
  - For release code level R3.2 or higher, introduction of TS7720 Tape Attached (TS7720T)
  - For release code level R3.2 or higher, add caution for applying Time Delayed Premigration to logical volumes whose secondary pool is copy export pool.
  - For release code level R3.2 or higher, Offsite Reclaim acceleration.
  - For release code level R3.3 or higher, customers that have E08 drives can choose to write copy export physical volumes in either 3592 E07 or E08 recording format.
  - For release code level R3.3 or higher, TS7700 supports heterogeneous E08 drive environments and Copy Export comes to support exporting different recording format physical volumes at one time.
- Version 2.4
  - For release code level R3.3 or higher, with the introduction of the JD media, the tape capacity can exceed 7 characters. There is a change in the Export Status File Records. The "Total Bytes Written" in the physical export volume record expanded from bytes 15-21 to bytes 15-22. Subsequently, all fields after the "Total Bytes Written" are shifted down by 1 byte. The total length of the physical export volume record remains unchanged at 80 bytes.
- Version 2.5
  - For release code level R2.1 or higher, add description about missing operation status ‘41’ for export status file records.
  - For release code level from R3.2 to R4.1.1, add message description of E0006 copy export progress message.
  - For release code level R4.1.2 or higher, add message description of E0006 copy export progress message.
  - For release code level R4.1.2 or higher, add note about new compression method for Copy Export Recovery.
  - For release code level R4.1.2 or higher, add description about fixed Offsite Reclaim behavior.
- Version 2.6
  - For release code level R5.0 or higher, add E0030 which is new copy export progress message.
  - For release code level R4.2 or lower, add message description of R0000 copy export progress message.
  - For release code level R5.0 or higher, add message description of R0000 copy export progress message.
- Version 2.7
  - Add description to recommend setting TVCWDEG=EQUAL and PRETHDEG=DISABLE to copy export recovery cluster.
  - Change description to clarify that copy export operation requires at least 4 available physical tape drives “for each installed drive type”.

Configurations Supported

The Copy Export function is supported on all configurations of the TS7700, including Grid configurations. In a Grid configuration, each TS7700 is considered a separate source TS7700. This means that only the physical volume exported from a source TS7700 can be used for recovery of a source TS7700. Physical volumes from more than one source TS7700 in a Grid configuration cannot be combined to use in recovery.

Recovery is only to a single cluster configuration. The TS7700 used for recovery must be configured as cluster 0. After recovery, the grid MES offering can be applied to recreate a Grid configuration.

To perform a copy export operation, the TS7700 must have a minimum of four available physical tape drives for each installed drive type.

Code Requirements

The Copy Export function for standalone configurations was introduced with TS7700 code level 8.3.x.x and library manager code level 535.x. For Grid configurations, the copy export function was introduced with TS7700 code level 8.4.x.x. Although there are no host software updates required to support the copy export function, there are other functions supported in the TS7700 that do require a later level of host software for support. One of those, host console request, does require z/OS support and that is provided at z/OS V1R6 and above. Refer to OAM APAR OA20065 and device services APARs OA20066, OA20067 and OA20313.

For the changes supported in version 1.2 of this white paper, the minimum code level for the TS7700 is 8.4.1.37.

For the changes supported in version 1.3 of this white paper, the minimum code level for the TS7700 is 8.4.1.57.

For the changes supported in version 1.4 of this white paper, the minimum code level for the TS7700 is 8.5.x.x and library manager code level 536.x for systems that have a 3494 library attachment.

For the changes supported in version 2.0 of this white paper, the minimum code level for the TS7700 is 8.20.0.115.

For the changes supported in version 2.1 of this white paper, the minimum code level for the TS7700 is 8.21.x.x and the code level on the recovery TS7700 must be at the same or higher code level as the source TS7700.

For the changes supported in version 2.3 of this white paper, the minimum code level for the TS7700 is 8.32.x.x.

For the changes supported in version 2.4 of this white paper, the minimum code level for the TS7700 is 8.33.x.x.

For the changes supported in version 2.5 of this white paper, the minimum code level for the TS7700 is 8.21.x.x.

Copy Export Operation Overview

Copy export provides a new function that allows a copy of selected logical volumes written to the TS7700 to be removed and taken offsite for disaster recovery purposes. The benefits of volume stacking, which places many logical volumes on a physical volume, are retained with this function. In addition, since the data being exported is a copy of the logical volume, the logical volume data remains accessible by the production host systems.

The basic steps for using copy export are:

1. Determine the data that is needed for offsite disaster recovery purposes. Through the automatic class selection routines, assign a management class that specifies a secondary volume pool to any data that is to be copy exported. As logical volumes are written to the TS7700 and then closed, they will be scheduled to be copied to a physical tape volume. With a management class that specifies a secondary copy pool, the data is copied both to a primary pool physical volume and a secondary pool physical volume. See the section on *Setting up Data Management Definitions for Copy Export*.
2. When it is time to remove the physical volumes that have a copy of the data on them, first write an Export List File volume to the TS7700 that is to perform the copy export operation. The export list file volume contains instructions for the copy export operation, one of the key instructions being the number of the physical volume pool to export. The export list file volume will also hold a status file that contains records generated by the TS7700 as part of the copy export operation. Second, once the export list file volume has been written and closed, issue the Library Export z/OS console command. See the sections on *Creating the Export List File Volume* and *Copy Export Operation*.

   Note: It is expected that customers will execute the copy export operation on a periodic basis, possibly even more than once a day. Since the purpose is to get a copy of the data offsite for disaster recovery purposes, performing it soon after the data is created minimizes the time for the recovery point objective.
3. In processing a copy export operation, the TS7700 first copies any logical volumes assigned to the pool being exported that only have a copy of the logical volume in the cache. Next, each of the physical volumes in the specified pool that contains active data is mounted and a database backup of the TS7700 is written to all or 4 of them. It can be selected by user at code level 8.21.x.x. See the sections on *Creating the Export List File Volume*. Status records are written to the export list file volume and then the physical volume is ejected from the library. Once all the physical volumes in the pool have been processed, the copy export operation is complete. See the sections on *Copy Export Progress Messages* and *Export Status File Records*.

   On the completion of the copy export operation, a summary status console message is generated. The status file on the export list file volume contains detailed information about the execution of the copy export operation and should be retained for future reference. See the section on *Host Completion Message*.
4. An operator removes the physical volumes from the I/O station of the library and prepares them for shipment to an offsite location. See the section on *Removing Copy Exported Volumes from the Library*.

If a copy export operation must be stopped, it can be canceled either through a host command or through the TS7700 on systems running 8.5.x.x code or higher or on the library manager for systems on pre 8.5.x.x code. See the section on *Canceling a Copy Export Operation*.

To use the copy exported physical volumes for recovery, the following are the basic steps to perform:

1. Place all of the copy exported physical volumes from the same source TS7700 into a library attached to an empty TS7700. See the section on *Planning and Considerations for the Recovery TS7700 and Library*.
2. Execute Copy Export Recovery. This is a selection through the recovery TS7700's management interface. A key piece of information to provide is the volume serial number of one of the last copy exported physical volumes on which database backup of the source TS7700 is recorded. The recovery TS7700 will use the database backup on that volume as part of the recovery process. See the section on *Performing Copy-Export Recovery*.

   Note: There are many sources for this volume serial number, including the last export list file volume's status file, on the library manager logs of the source library for systems running pre 8.5.x.x code, or host console logs of the source host. For systems running 8.21.x.x or higher, not all volumes will contain a valid database backup that can be used for recovery. See section on *Export Status File Records – Physical Export Volumes*.
3. Monitor the progress of the recovery through the management interface.
4. Restore the host environment. This can be performed in parallel with the copy export recovery operation. See the section on *Restoring the Host Environment and Library Environment*.
5. After the recovery completes, only the secondary copy of data exists for systems at R1.5 or higher. On pre 1.5 systems only a primary copy of volumes exists after recovery. To create a new primary/secondary copy of data ready for production refer to the section Creating a New Primary/Secondary Copy After Disaster Recovery.
6. Once the copy export recovery operation has completed, you can vary the TS7700s virtual drives online to the host and resume processing.
7. If you plan on writing data to the recovered TS7700, you will need to insert logical volumes to be used as scratch volumes.
8. You will need to add scratch physical volumes to the recovery TS7700 even if you are only planning on reading data. A minimum of 2 scratch volumes per defined pool in the TS7700 is needed to prevent the TS7700 from entering the out of scratch state. In addition, a minimum of 3 scratch volumes are required for pool 0. In the out of scratch state, logical volume mounts are not allowed.

To manage the Copy Exported Physical Volumes:

1. There is a default limit of 2000 copy exported physical volumes per TS7700. Prior to performing the operation, it is a good idea to see how many volumes have already been exported. You can use the Library Request host console command to view the number of copy exported volumes by pool in a specific library. See the sub-section on *Pre-execution Checking* in the section on *Copy Export Operation*. At code release level R1.6 and higher, the limit can be changed through the management interface (Service & Troubleshooting > Copy Export Settings). The value can be adjusted to a maximum of 10000.
2. From time to time, you will want to bring back copy exported volumes that no longer have any valid data on them from the offsite location for reuse. You can find out how much active data is on copy exported physical volume by using the Physical Volume Status function of the Bulk Volume Information Request function. See the section on *Checking the Status of Copy Exported Physical Volumes*. Even if the Physical Volume Status reports some emptied copy exported volumes, you should not bring back them to the library until you execute next copy export. Because DB backup written at

latest copy export had the entries of the volumes as not empty. You should bring the emptied copy exported volumes to the library after you confirm they are empty on copy export status file at next copy export.

3. The copy exported physical volumes continue to be managed by the source TS7700 in terms of space reclamation. You can allow the TS7700 to determine when to reclaim a copy export physical volume or you can manually cause a volume to be reclaimed. See the section on *Reclamation of Copy Exported Physical Volumes*.
4. The current copy export functionality allows the host to mark a subset of volumes to either be immediately ejected to the IO station or be held in the library so that they can be ejected from the library at another time. The second option allows the user to determine a better time to retrieve these volumes from the library without them sitting in the IO station. For customers running 8.21.x.x code or higher, they have the option to re-insert volumes in the held state without removing them from the library. For customers running pre 8.21.x.x in order to re-insert a held volume it needs to be ejected first.

General Considerations for Copy Export:

Here are some general considerations that you will need to be aware of in using the copy export function of the TS7700:

1. The library associated with the TS7700 executing the copy export operation must have an I/O station feature for the operation to be accepted. You should empty the I/O station prior to executing copy export and avoid having it get into the full state.
2. On systems running pre 8.5.x.x code, the Import/Export function must have been enabled on the library manager for copy export operations to be performed. A service representative uses the Enable/Disable function of Utilities on the Service menu to do this.
3. Only one copy export operation can be performed at a time.
4. During the execution of a copy export operation, if the TS7700 cannot access the primary copy of a logical volume and the secondary copy exists in a pool defined for copy export, regardless of whether that pool is involved in the current copy export operation, TS7700 can't access the secondary copy and will fail the mount. When a copy export operation is not being performed, if the primary copy of a logical volume cannot be accessed and the secondary copy exists, the secondary copy is accessed and a new primary copy is created.
5. Copy export and insertion of logical volumes are mutually exclusive functions in a TS7700 or Grid.
6. The export list file volume cannot be assigned to the secondary copy pool that is specified for the operation. If it is, the copy export operation will fail.
7. A minimum of four physical tape drives for each installed drive type must be available to the TS7700 for the copy export operation to be performed. The operation will be terminated by the TS7700 when fewer than four physical tape drives are available. Processing for the physical stacked volume in progress when the condition occurred will be completed and the status file records will reflect what was completed before the operation was terminated.
8. If a scratch physical volume is needed during a copy export operation, the secondary physical volume pool must have an available scratch volume or access to borrow one for the operation to continue. If a scratch volume is not available, the TS7700 will indicate this through a console message and wait for up to 60 minutes. If a scratch volume is not made available to the secondary physical volume pool within 60 minutes, the copy export operation is terminated.

9. Only one secondary physical volume pool can be specified per export operation and it must have been previously defined as a copy export pool.
10. Specific logical volumes are not specified as part of a copy export operation, rather all valid logical volumes on the physical volumes in the specified secondary pool will be considered for being exported. After the first time copy export is performed for a pool, the logical volumes that will be exported are only the ones for that pool that have been newly written or modified since the last export began. For recovery, all exported physical volumes that still contain active data from a source TS7700 need to be included as not all of the logical volumes created are going to be on the last set exported.
11. During execution, if the TS7700 determines that a physical volume assigned to the specified secondary pool contains one or more primary logical volumes, that physical volume and any secondary logical volume on it are excluded from the copy export operation.
12. Logical volumes are stacked on physical volumes managed by a TS7700. They are not directly readable by a physical tape drive. They can only be accessed through a TS7700.
13. The primary copy of the logical volumes exported remains in the inventory of the TS7700 and Grid.
14. A physical volume written in a pre-TS7700 format cannot be exported. The Physical Volume Status request of the BVIR function can be used to obtain information about the physical volumes in a pool. Included in that information is the format the volume was written in. If any of the volumes are still in the pre-TS7700 format, use the physical volume move function of the library manager to force a conversion of the data on the volume to the TS7700 format. Also see the description in section *Copy Export Operation*, pre-execution checking for more details.
15. When a copy export operation is initiated, only those logical volumes assigned to the secondary pool specified in the Export List File Volume that are resident on a physical volume of the pool or in the cache of the TS7700 performing the export operation will be considered for export. For a Grid configuration, if a logical volume is to be copied to the TS7700 that will be performing the copy export operation, but that copy had not yet completed when the export is initiated, it will not be included in the current export operation.
16. Logical volumes to be exported that are resident only in the cache and not mounted when the copy export operation is initiated will be copied to stacked volume in the secondary pool as part of the copy export operation.
17. Any logical volume assigned to the specified secondary pool in the TS7700 after the copy export operation is initiated is not part of the export and will be written to a physical volume in the pool but will not be exported. This includes host as well as copy sourced data.
18. To minimize the number of stacked volumes used for copy export, you should use the highest capacity media and physical drive format that is compatible with the recovery TS7700. The number of concurrent tape devices can be changed via Maximum Devices in pool properties setting. This can reduce the number of concurrent tape devices that the TS7700 will use when copying data from cache to the secondary copy pool used for copy export.
19. All copy exported volumes exported from a source TS7700 must be placed in a library for recovery. The source TS7700 will limit the number of physical volumes that can be copy exported to approximately 2000 to ensure that they will all fit into the receiving library. At code release level R1.6 and higher, the value can be changed to a maximum of 10000.
20. The recovery TS7700 must have physical tape drives that are capable of reading the physical volumes from a source TS7700.

The supported drive verses tape combinations are illustrated in the table below:

Copy Exported Tapes	Drive Type J1A	Drive Type E05	Drive Type E06	Drive Type E07	Drive Type E08
Any J1A format	X	X	X	X	-
Any E05 format	-	X	X	X	-
Any E06 format	-	-	X	X	-
Any E07 format	-	-	-	X	X (can't read JB/JX media)
Any E08 format	-	-	-	-	X

If a source TS7700 writes the volumes using the native E05 format, then the recovery TS7700 must also have 3592 E05 drives running in native format mode or 3592 E06/E07 drives. If the exporting pool on the source TS7700 is set up to encrypt the data, then the recovery TS7700 must also be set up to handle encrypted volumes and have access to the encryption key manager with replicated keys from the production site. If the source TS7700 writes the volumes in J1A or emulated J1A mode, then any 3592 model drive in the recovery TS7700 can read the data.

21. If the copy export tapes are being used for recovery, the recovery TS7700 cannot contain any previous data and the recovery process basically cannot merge data from more than one source TS7700 together. However, for customers running 8.21.x.x code on an existing TS7700, a service offering is available where a customer can merge data from a copy export backup tape into an existing TS7700 (either stand-alone or grid). Please contact your sales team for information.
22. As a part of copy export recovery, an option is provided to erase any previous data on the TS7700. This allows a TS7700 that is used for disaster recovery testing to be re-used for testing of different source TS7700's data.
23. The physical and logical volumes exported during a copy export operation are not known by the tape management system. You can use the export status file to keep track of the volumes or use the information to manually update tape management system records.
24. If the number of volumes recovered on the recovery TS7700 exceeds 1 million volumes, the system will be blocked from inserting additional logical volumes until the appropriate number of 5270 feature codes are installed. Each instance of this feature increases the number of logical volumes supported by 200,000.
25. If the customer has feature code 5271 Selective Device Access Control installed on the source TS7700, the associated management class policies will be restored on the recovery TS7700. Feature code 5271 will need to be installed on the recovery TS7700 in order for these policies to take effect.
26. On systems running 8.21.x.x code or higher, if the customer exports a high number of volumes per pool with each export request, they may want to consider using the copy export accelerator. When a customer runs a LXPT request, the following sequence is performed:
    1. Finish pre-migration to any volume targeted for the copy export pool.

2. Backup DB.

3. Mount each tape in the copy export pool and copy the DB to the tail end.

4. Eject the tapes or move them to copy export hold.

5. Finish out the export list volume with status.
In 8.21.x.x or higher, there is a new option available to limit the number of export cartridges that will contain a database backup. The customer can set the new option on the Copy Export List volume. If this option is set, the database backup will be appended to the first two export tapes and the last two export tapes. Any one of the four tapes containing the backup can be used for disaster recovery of the pool. The export process is sped up because only a maximum of four of the export tapes are remounted to append the backup database.

27. If the customer has feature code 5273 Enable Tape Attach installed on TS7720 whose code level is 8.32.x.x, it comes to be TS7720 Tape Attach (TS7720T). TS7720T can perform copy export operation.
28. Both TS7740 and TS7720T can perform copy export operation. At copy export recovery, the copy export sets can be used to restore data at a location that has equal or newer physical tape drive and equal or newer TS7700 microcode. TS7720T copy export set can be restored into both TS7740 and TS7720T. TS7740 copy export set also can be restored into a both TS7740 and TS7720T.
29. If the logical volumes are assigned to CP0 in TS7720T, the logical volumes are resident only and never copied to any physical volumes. Hence, logical volumes in CP0 can’t be exported.
30. When using the Copy Export acceleration (LMTDBPVL) option, the database backup is appended only to the first two and the last two volumes that are exported. These corresponding tapes with the database backup are selected and listed in the alphabetical order of the physical tape VOLSER. If the LMTDBPVL option was set, and there is a failure appending the DB backup, a different physical volume is selected to contain the database backup so that four physical volumes have the DB backup.
31. The Copy Export operation might fail depending on the combination of installed tape drives, media types, or recording formats of physical volumes in the secondary pool, and the existence of LMTDBPVL option. Exportable physical volumes are explained in detail in the table below. If unexportable physical volumes are included in the Copy Export set physical volumes, the Copy Export operation fails and returns message CBR3856I
32. When LMTDBPVL option is enabled and export format is default, physical volumes which are unwritable by installed tape drives are exportable. However, to export such physical volumes, at least one writable physical volume needs to be included in Copy Export set because Copy Export needs to append DB backup to the physical volume to export for recovery.

Installed tape drives	Export format of copy export pool	LMTDBPVL enabled?	Exportable physical volumes
E08 only	Default	Yes or no	JC/JK in E07 format and JC/JK/JD/JL in E08 format
	E08		JC/JK/JD/JL in E08 format
	E07		JC/JK in E07 format
E08 and E07	Default	Yes	Any media types in any recording format
	D08		JC/JK/JD/JL in E08 format
	E07		JB/JC/JK in E07 format
	Default	No	JB in E06 format, JB/JC/JK in E07 format, and JC/JK/JD/JL in E08 format
	E08		JC/JK/JD/JL in E08 format
	E07		JB/JC/JK in E07 format
E08 and E06	Default	Yes	JA/JJ in J1A format, JA/JJ/JB in E05/E06 format, JC/JK in E07 format, and JC/JK/JD/JL in E08 format
	E08		JC/JK/JD/JL in E08 format
	E07		JC/JK in E07 format
	Default	No	JA/JJ/JB in E05/E06 format, JC/JK in E07 format, and JC/JK/JD/JL in E08 format
	E08		JC/JK/JD/JL in E08 format
	E07		JC/JK in E07 format
E08 and E05	Default	Yes or no	JA/JJ in J1A format, JA/JJ/JB in E05 format, JC/JK in E07 format, and JC/JK/JD/JL in E08 format
	E08		JC/JK/JD/JL in E08 format
	E07		JC/JK in E07 format
E08 and J1A	Default	Yes or no	JA/JJ in J1A format, JC/JK in E07 format, and JC/JK/JD/JL in E08 format
	E08		JC/JK/JD/JL in E08 format
	E07		JC/JK in E07 format
E07 only	Default	Yes or no	JB in E06 format and JB/JC/JK in E07 format
	E08		JB/JC/JK in E07 format
	E07		JB in E06 format
E06 only	Default	Yes or no	JA/JJ/JB in E05/E06 format
E05 only	Default	Yes or no	JA/JJ in J1A format and JA/JJ/JB in E05 format
J1A only	Default	Yes or no	JA/JJ in J1A format

If you are going to be using copy export in a Grid configuration, you should also see the section on *Grid Considerations for Copy Export*.
The subsequent sections in this white paper will delve into the details of each step as well as into the format of the export list file volume, host console messages and options.

Setting up Data Management Definitions for Copy Export

With DFSMS, you control where data is stored and how it is managed through a set of names associated with a logical volume during allocation. The names are called storage constructs, and storage construct names have policies associated with them that define where and how data is stored and managed. One of the constructs, Storage Group, is used to manage where the primary copy of a logical volume's data is stored. For the TS7700, a group of physical data storage cartridges, referred to as a physical volume pool, can be associated with a storage group construct name. Logical volumes that are assigned the storage group name are copied from the tape volume cache to the physical volume pool associated with that name. Another construct, Management Class, is used to control where additional copies of the logical volume are to be made. One of the options of management class is to specify that a second copy of a logical volume is to be made. Like storage group, a physical volume pool is associated with a management class name to hold the secondary copy. Logical volumes that are assigned the management class name are copied to the physical volume pool associated with that name. Using management class to specify a secondary pool allows for two copies of a logical volume's data to be stored in the TS7700, each on a separate physical volume, to provide for recovery if the primary physical volume is damaged or misplaced. This ability to make a second physical copy of a logical volume's data is core to the copy export function.

A TS7700 supports up to 32 different physical volume pools. Normally, a physical volume pool can be used as a storage location for either a primary or secondary copy of a logical volume's data, but no restriction is made to prevent storage group and management class name definitions to specify the same pool number. With copy export, this changes. A physical volume pool that is to be used for copy export cannot contain the primary copy of any logical volume's data, because then a subsequent copy export would remove that primary copy. A pool's properties definition must explicitly specify whether or not it will be used for copy export. If a pool's properties indicate that it is to be used for copy export, the pool cannot later be associated with a storage group name definition. If a pool is already associated with a storage group name, the pool's properties cannot be modified to indicate that it is to be used for copy export.

Note: In setting up for copy export, you are not restricted to defining a single physical volume pool for copy export. You may want to define more than one management class with an associated different physical volume pool for data that is to be copy exported to different sites or to keep like application data together.

For copy export, you will be defining at least one additional physical volume pool. As part of that definition, you will need to decide how physical volumes become part of a pool and how they will be reclaimed.

Physical volumes become part of a physical volume pool either by 1) being explicitly assigned to the pool as the volumes are inserted into the library, or 2) by being borrowed from the common scratch pool when needed or 3) moved to the pool using the move physical volumes function of the TS7700 or the stacked volumes function on the library manager for pre 8.5.x.x systems. Prior to inserting physical volumes, if volumes are to be explicitly assigned to a pool during insert, set up a volume serial number range for a specific pool using the Physical Volume Ranges on the TS7700 or the Volser Range window on the library for pre 8.5.x.x systems and 3494 attached libraries. A pool can 'borrow' physical volumes from the common scratch pool when needed and optionally 'return' them to the common scratch pool when they have been reclaimed. Borrow and return rules are also specified as part of the definition for a physical volume pool. With the move physical volume function, one or more scratch physical volumes can be moved from one pool to another. A physical volume that has valid logical volumes on it can also be moved, however, the logical volumes are first copied to another physical volume in the originating pool.

There are six primary steps in setting up the data management definitions and controls for copy export:

1. Decide on Management Class construct name(s)

   As part of the plan for using the copy export function, you need to decide on at least one Management Class construct name. It is suggested that the name be meaningful and perhaps relate to the type of data to reside on the pool or the location the data is to be sent. For example, if the pool is to be used to send data to the primary disaster recovery site in Atlanta, a name like "MCPRIATL" could be used. "MC" for management class, "PRI" indicates it is for the primary recovery site and "ATL" indicates Atlanta. Up to an eight character name can be defined.

2. Define the Management Class names to DFSMS and the TS7700

   Once the management class names are selected, the names must be defined to DFSMS and to the TS7700. The following descriptions cover the basics and do not necessarily cover all the options that may be available. For DFSMS, refer to the *z/OS DFSMSdfp Storage Administration Reference*, SC26-7402. For the library manager on systems running pre 8.5.x.x code, refer to the *IBM TotalStorage 3494 Tape Library Operator Guide*, GA32-0449 or the *IBM 3953 Library Manager Model L05 Operators Guide*, GA32-0558. The IBM Redbook, *IBM System Storage Virtualization Engine TS7700: Tape Virtualization for System z Servers*, SG24-7312, is another good source for information on setting up a TS7700 implementation.

   For DFSMS, the following steps are used to define each Management Class name:

   Ÿ Begin by selecting the **Management Class** option from the ISMF Primary Option Menu for storage administrators panel.

   Ÿ On the Management Class Application Selection panel:

      1. Enter the **CDS Name** (control data set) you are using for the DFSMS system.
      2. Enter a one to eight-character alphanumeric name in the **Management Class Name** field.
      3. Select - **3. Define** and press enter

   Ÿ On the Management Class Define panels:

      1. Optionally enter a description for the management class name in the **Description** field on the first panel.
      2. Accept the defaults for all settings. Press enter to move through the five definition panels.

      Note: None of the settings are actually used for system managed tape. All settings associated with a management class name are defined through the TS7700 or on the library manager for pre 8.5.x.x code levels, not the DFSMS panels.

   The steps used on the TS7700 to define each Management Class name and to associate a specific pool with the name can be found in Appendix A – Management Class Definition for systems running 8.30.x.x or higher code, Appendix B – Management Class Definition for systems running from 8.5.x.x to 8.21.x.x or higher code and Appendix C – Management Class Definition for pre 8.5.x.x systems.

3. Define the volser ranges for the 3592 media

   You must define the volser range(s) for the physical volumes that are to be used by the TS7700. As part of the definition, you can optionally associate a specific range of physical volumes with a pool. If you do not specifically associate physical volumes with a pool, you will need to enable the pool to borrow as needed from the common scratch pool (pool 0).

The steps used to define volser range(s) can be found in Appendix A – Volser Range Definition for systems running 8.30.x.x or higher code, Appendix B – Volser Range Definition for systems from 8.5.x.x to 8.21.x.x and Appendix C – Volser Range Definition for pre 8.5.x.x systems.

Note: For the physical volumes that you use for copy export, defining a specific volser range to be associated with a secondary pool on a source TS7700 may simplify the task of knowing the volumes to use in recovery and in returning a volume that no longer has active data on it to the TS7700 that manages it

Note: When a volser range changes, the media types and storage pools for existing volumes in the library do not change. Volumes inserted subsequently reflect the new set of ranges and associated media types and storage pools. A volser range cannot conflict with existing volsers of a different media type.

4. Define the characteristics of the physical volume pools used for Copy export to the library by following the procedures found in Appendix A – Manage Physical Volume Pool Properties for systems running 8.30.x.x or higher code, Appendix B – Manage Physical Volume Pool Properties for systems from 8.5.x.x to 8.21.x.x and Appendix C – Manage Storage Pool Properties for pre 8.5.x.x systems.

   If the customer has E07 or E08 drives installed, then from the Management Interface, a customer would have a new option in Pool Properties that will allow them to select a desired recording format for an Export Pool. This field is called Copy Export Recording Format, and can only be assigned to a pool that is defined as an Export Pool. The Copy Export Recording Format should be set previous to having any data written to the pool to ensure that all the physical tapes within the pool are of the desired recording format. Once the Copy Export Recording Format is set to a desired recording format, then the physical tapes that are written from that point on will be of the specified recording format. Since the recording format was established at the beginning of the use of pool, the tapes exported will have the desired Copy Export Recording Format. Copy Export Recording Format should be set as the format readable at the recovery site.

   The following values are valid as Copy Export Recording Format. Selectable value depends on which drive types are in the library:

   Default The highest common format supported across all drives in the library. This the default value.
   E06 Format of 3592-E07 Tape Drive
   E07 Format of 3592-E07 Tape Drive
   E08 Format of 3592-E08 Tape Drive

5. Code/modify the management class Automatic Class Selection (ACS) routine

   Add selection logic to the management class Automatic Class Selection (ACS) routine to assign the new Management Class name(s) as appropriate. For example, if all jobs with the high level qualifier BACKUP_DATA are to be written to a TS7700 and be taken offsite with copy export, then a portion of the ACS filter routine would include:

```
WHEN &HLQ EQ 'BACKUP_DATA'
  DO
    SET &MCLASS = 'MCPRIATL'
  EXIT
  END
```


6. Activate the new construct names and ACS routines

   Before new allocations will be assigned the new management class, the source control data set (SCDS) with the new management class definitions and ACS routines must be activated.

Creating the Export List File Volume

For the TS7700 to perform a copy export operation, you must first provide it with the information about which data to export as well as any options to use during the execution of the operation. The information is provided to the TS7700 through a logical volume. That logical volume can be any of the ones defined for the TS7700 and is typically selected as a scratch volume by the job that is to create the export list file volume. The export list file volume is a standard IBM labeled volume that contains three files:

1. Export List file
2. Reserved file
3. Export Status file

All records written to these files are 80 bytes in length and done without compression (make sure you code your JCL with TRTCH=NOCOMP). The Export List file contains records that tell the TS7700 how to perform the export operation. The Reserved file is just that, it is reserved for future use, when written it only contains a single record - a header identifying it as the reserved file. For the Export Status file, the job that creates the Export List file volume will only write a single record - a header that identifies it as the Export Status file. During the execution of the copy export operation, the TS7700 will append records to the Export Status file. On completion of the copy export operation, the Export Status file then provides a record of the details of the copy export operation.

Like any files you write to a tape, you determine the actual names, decide whether to catalog them, etc..

Note: It is recommended that the Export List file volumes used for each of the copy export operations performed be kept because of the Status file information. Alternatively, the Status files could be copied to DASD or other tapes for long term retention. You should consider how you will retain the status files when choosing a name for the file.

In a Grid configuration, the export list file volume must only be valid on the TS7700 that is to perform the copy export operation. To do this, you will need to set up a Management Class name that specifies that only the TS7700 that will be performing copy exports is to have a copy and then code your ACS routine to assign that management class name whenever the export list file volume is created for that TS7700.

Note: See the section on *Grid Considerations for Copy Export*.

You will create the following records for the three files:

Export list file:

The export list file specifies the secondary physical volume pool to export along with options.

The first record of the export list file is the file identifier and version number and must be specified as illustrated below, starting in the first column:

`EXPORT LIST 03` <user field>

Note: To distinguish copy export from prior VTS generations of export, all export list volumes for copy export have a version number of 03.

The optional user field is a maximum of 16 characters long, separated with a blank from the version number.

Following the export list file identifier record is the export parameter record. It is used to specify the pool to export (in this example it is pool 09). Copy Export does not support exporting multiple pools at one time. Only one pool can be specified. It must be specified as illustrated below, starting in the first column:


```
EXPORT PARAMETERS PHYSICAL POOL TO EXPORT:09
```

For pools 1-9, you must specify them as 01 through 09.

Following the export parameter record you can optionally include an options record. Through the options record you can:

- Specify that exported physical volumes are to be directly ejected to the I/O station rather than be placed in the export-hold category. If it is not specified, exported physical volumes are placed in the export-hold category. On systems that are running R1.7 or higher, if a physical volume in the copy export-hold category goes empty and it is still in the library it will be returned to READ-WRITE status and its home pool for reuse on the next copy export execution.
- Specify that the export is a copy export. If it is not specified, it is assumed to be a copy export operation.

The fields in the options record are separated by a comma and can be in any order after the record identifier OPTIONS1. OPTIONS1 must start in the first column. The following values are valid options:

Option	**Description**
COPY	Perform a copy export. This is a required option.
EJECT	If specified, physical volumes are ejected to the I/O station when the export completes. If this option is not specified, physical volumes are left in the library but marked as export hold.
LMTDBPVL	Export accelerator. If more than five physical cartridges are exported the backup will only be appended to the first two and last two cartridges.

Here are a couple of examples:

For copy export where the physical volumes would be placed in the export-hold category for later handling by an operator:

```
OPTIONS1,COPY
```

For copy export where the physical volumes are to be directly ejected to the I/O station:

```
OPTIONS1,COPY,EJECT or OPTIONS1,EJECT,COPY
```

For copy export where the customer wants to leverage the accelerator option and only append the database backup for recovery to four of the exported tapes. If fewer than five tapes are exported all will have the backup. With this command the volumes will be marked as export hold and kept in the library:

```
OPTIONS1,COPY,LMTDBPVL
```

For copy export where the customer wants to leverage the accelerator option and eject the pvols when the export completes:

```
OPTIONS1,COPY,EJECT,LMTDBPVL or OPTIONS1,COPY,LMTDBPVL,EJECT
```


Reserved file:

The second file on the export list volume is reserved for future use. Even though it is presently not used, you must create this file. It must contain at least one record, although the TS7700 does not check its contents. For example, you could create a record as:

```
RESERVED FILE
```

Export status file:

The third file on the export list volume is used by the TS7700 for storing status information from the copy export operation. You must create the file with one record as illustrated below, starting in the first column:

```
EXPORT STATUS 01 <user field>
```

The optional user field is a maximum of 16 characters long, separated with a blank from the version number.

After the copy export operation is completed, this file contains additional records reporting on the export results including the logical volumes exported and the status of all physical volumes in the copy-exported state.

Note: The TS7700 may update the version number on the status file record that was written as additional information is added to the status file.

A basic utility like IEBGENER is the simplest way to create the export list file volume. The following is sample JCL which writes the required files on the export list volume using a scratch volume (assumes the secondary physical volume pool used for copy export is pool 09 and the physical volumes are to be directly ejected):

```
//EXPORT JOB 1,'EXPORT',MSGLEVEL=(1,1)
//*************************************
//* DO NOT USE COMPACTION WHEN WRITING THE REQUEST FILE
//* SUBSTITUTE YOUR OWN DATA SET NAMES, JOB NAME, ETC.
//*
//*************************************

//* FILE 1: EXPORT LIST
//*************************************
//STEP1 EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=*
//SYSIN DD DUMMY
//SYSUT2 DD DSN=HILEVELQ.EXPLIST,
// UNIT=VTS1,DISP=(NEW,KEEP),LABEL=(1,SL),
// VOL=(,RETAIN),
// DCB=(RECFM=FB,BLKSIZE=80,LRECL=80,TRTCH=NOCOMP)
//SYSUT1 DD *
EXPORT LIST 03
EXPORT PARAMETERS PHYSICAL POOL TO EXPORT:09
OPTIONS1,COPY,EJECT
/*
//*************************************
//* FILE 2: RESERVED FILE
```



```
//*************************************
//STEP2 EXEC PGM=IEBGENER,COND=(4,LT)
//SYSPRINT DD SYSOUT=*
//SYSIN DD DUMMY
//SYSUT2 DD DSN=HILEVELQ.RESERVED,
// UNIT=VTS1,DISP=(NEW,KEEP),LABEL=(2,SL),
// VOL=(,RETAIN,REF=*.STEP1.SYSUT2),
// DCB=*.STEP1.SYSUT2
//SYSUT1 DD *
RESERVED FILE
/*
//*************************************
//* FILE 3: EXPORT STATUS FILE
//*************************************
//STEP3 EXEC PGM=IEBGENER,COND=(4,LT)
//SYSPRINT DD SYSOUT=*
//SYSIN DD DUMMY
//SYSUT2 DD DSN=HILEVELQ.EXPSTATS,
// UNIT=VTS1,DISP=(NEW,CATLG),LABEL=(3,SL),
// VOL=(,,REF=*.STEP1.SYSUT2),
// DCB=*.STEP1.SYSUT2
//SYSUT1 DD *
EXPORT STATUS 01
/*
```


Copy Export Operation

Once the export list file volume has been written to the TS7700 that is to execute the copy export operation, you will need to initiate the operation.

Pre-Execution Checking

But before you initiate the operation, you may want to check to ensure that the TS7700 has the needed physical drives and scratch physical volume resources and that it is not near the limit of the number of physical volumes that can have a status of copy exported. You should also be sure that the I/O station is empty. If you had migrated from a B10 or B20 VTS to the TS7700 using the outboard migration method, you may have data that is still in the older VTS format. The TS7700 cannot export data in the old format, so you should check to see if any of the data to export was written with the old format. Also, if that data was assigned to a pool that is now to be used for copy export, the older format VTS volumes are likely primary volumes and cannot be exported.

To check that the TS7700 has at least four available physical tape drives of each installed drive type, you can use the Library Request host console command that specifies the PDRIVE request. This will return status on all of the physical drives in the TS7700. If there are fewer than four physical drives available, you will need to call for service to repair drives prior to performing the copy export operation.

Here is an example of the data returned by the PDRIVE request:

```
PHYSICAL DRIVES V1
   SERIAL NUM     TYPE  MODE  AVAIL  ROLE  POOL    PVOL    LVOL
 000007878161 3592E05E  E05E      Y  RCLS    01  S70470  Z09866
 000007878175 3592E05E  E05E      Y  MIGR    01  JA8149  Z04381
 000001365176 3592E05E  E05E      Y  RCLT    01  S70421  Z09866
 000001365177 3592E05E  E05E      Y  MIGR    01  JA8145  Z08629
 000001365137 3592E05E  E05E      Y  RCLS    03  310112  XC4487
 000001365181 3592E05E             Y  IDLE    00
 000007878194 3592E05E             Y  IDLE    00
 000007878312 3592E05E  E05E      Y  RCLT    03  S70479  XC4487
```

It shows that the TS7700 has eight available drives.

To check that the pool to be exported has sufficient scratch physical volumes and that the TS7700 is under the 2000 volume limit for copy exported volume on all pools, you can use the Library Request host console command that specifies the POOLCNT request. This will return the counts for the scratch physical volumes by pool and also the number of physical volumes that have a status of copy exported by pool. Ensure that the pool you are going to export has at least one scratch physical volume and that the total across all pools for physical volumes with a status of copy exported is less than 2000. If there are insufficient scratch volumes available for the pool, you should address that prior to attempting to execute copy export. If the copy export operation needs a scratch volume and one is not available, it will stop and wait for up to 60 minutes for you to make scratch volumes available. If scratch volumes are not made available within 60 minutes, the copy export operation is terminated. If the TS7700 is already at the 2000 volume limit (it could be over by a few volumes), you will need to reduce that number before a copy export can be executed. See the section on *Reclamation of Copy Exported Physical Volumes*. At code release level R1.6 and higher, the 2000 volume limit can be changed to a maximum of 10000.

Here is an example of the data returned by the POOLCNT request, with pools 3 & 4 being used as secondary pools for copy export:


```
"PHYSICAL MEDIA COUNTS V2 .0                                                  "
" POOL MEDIA  EMPTY  FILLING   FULL  ERASE    ROR  UNAVAIL  CXPT        "
"    0    JA     18                                    0               "
"    0    JJ     12                                    0               "
"    0    JC      8                                    0               "
"    1    JA      2        0      1      0      0        0      0       "
"    1    JC      2        1      0      0      0        0      0       "
"    3    JJ      2        0      0      0      0        0      0       "
"   10    JA      2        0      3      0      0        0      3       "
"   10    JJ      0        0      3      0      0        0      3       "
"   10    JC      2        0      2      0      0        0      2       "
```

Both pools meet the scratch criteria (98 and 19 available for pools 3 & 4, respectively) and the total number of copy exported physical volumes is 297 (sum of count for pools 3 & 4), far less than the 2000 limit.

To check whether the pool contains any pre-TS7700 format volume, use the BVIR - Physical Volume Status Pool xx function, where xx is the pool that you are going to use in a copy export operation. For each of the physical volume records returned, check the value for the ADSM_FORMAT_FLAG field. If a value of 1 is indicated, the volume is written in the pre-TS7700 format and must be converted before the logical volumes on it can be exported. If there are just a few physical volumes that you need to check on, an alternative method would be to use the host console request function, Library Request, to request information on a specific physical volume. The data returned will identify the format as either TS7700 or VTS. If VTS is identified, the volume is written in the pre-TS7700 format and must be converted before the logical volumes on it can be exported.

To convert the pre-TS7700 format logical volumes so that they can be exportable, you will need to set-up host jobs that will mount and then demount them. This will bring them back into the cache and the TS7700 will see that they need to be converted. In addition, if they did not have a secondary copy in the physical volume pool being used for copy export, a secondary copy is also made (assuming that they have a management class assigned that is defined for a secondary copy).

Initiating the Copy Export Operation

To initiate the copy export operation, you would issue the z/OS host console command:

`LIBRARY EXPORT,`*`volser`*

Where: *volser* is the volume serial number of the export list file volume you created.

The host will send a command to the composite library that the export list file volume was created in. If issued to a Grid configuration, the TS7700 will internally route the command to the TS7700 that contains the valid export list file volume. If more than one TS7700 in a Grid configuration contains a valid copy of the export list file volume, the copy export operation fails.

Copy Export Processing

The executing TS7700 validates the export operation request, checking that the required resources are available, the export list file volume is valid on the TS7700, it is correctly written and the parameters and options specified are compatible with the TS7700. It also checks if performing the operation would result in more than 2000 copy exported physical volumes. If the TS7700 determines that there are issues with starting the execution of the copy export operation, it will return a completion code to the host that initiated the operation. Refer to the *Export Completion Messages* section for the description of the completion codes and any associated text.

Note: It is possible that if enough logical volumes had been only in cache at the start of the operation, a few additional physical volumes will be used during the export operation and that may result in slightly more than 2000 volumes total that have been exported. Even though the number of copy exported volumes exceeds 2000, the copy export operation will continue execution, but subsequent copy export operations will fail until the number of volumes is again under the limit. At code release level R1.6 and higher, the 2000 volume limit can be changed to a maximum of 10000.

The export operation then continues processing as follows:

- The TS7700 determines the logical volumes to be exported. When the operation begins, a logical volume must:
  - Be assigned to the management class that defined the secondary physical volume pool specified in the export list file
  - Must have a valid copy of the volume resident in the TS7700. A logical volume does not have to be actually on one of the physical volumes in the pool at the beginning of the operation to be considered, it can be resident only in the cache. In a Grid configuration, if the volume's copy policy specified that it is to have a copy on the TS7700 performing the export, but the copy had not completed when the operation began, it is not considered for export during the operation.
  - If the volume is only in the cache, it must be scheduled to be copied to the secondary physical volume pool. When a volume is closed it is checked to determine whether it had been written to. If that was the case, it is added to the queue for copying to the physical volume pools defined by the volume's storage group and management class storage constructs associated with the volume.
  - At code release level R3.2 or higher, if Time Delayed Premigration is applied to a logical volume by the volume's storage class associated with it, the logical volume is not added to the queue for copying to the physical volume pools and keeps resident state until configured Premigration Delay Time has passed since its Premigration Delay Reference time (Volume Creation time or Volume Last Accessed time). This means that logical volumes to which Time Delayed Premigration is applied and whose Premigration Delay Time has not passed yet can't be candidates to be exported even if their secondary pool is configured as copy export pool. This is a point which should be kept in mind.

  Note: At code release level R2.0 and lower, if a mount request is processed for a volume that is queued to be copied to a physical volume pool, it is removed from the queue as part of mount processing. It is not automatically requeued when the volume is closed if it was only read while mounted. It will be requeued as part of a background process that scans the cache looking for cache-resident only volumes that need to be copied to their physical volume pool(s). The background process runs approximately every 4 hours. This means that it is possible for a volume to be resident in the cache, associated with the secondary physical volume pool to be exported and not be considered for the export operation because it had been removed from the queue. It would be eligible for a subsequent copy export operation once it had been requeued. At code release level R2.1 and higher, a volume queued to be copied to a physical volume pool is not removed from the queue by mount processing for only reading.

  Logical volumes assigned to the secondary physical volume pool after the operation begins or those that do not have a valid copy resident in the TS7700 are not considered (they could be considered in a subsequent copy export operation). Also, if a physical volume in the specified secondary physical volume pool contains one or more primary copies of logical volumes or the volume is written in a pre-TS7700 format, that physical volume and any logical volumes on it are not considered for export. If a logical volume meets some, but not all of the criteria to be exported during the operation, those volumes

are identified by writing export status file records for them. Refer to the *Export Status File Records* section for the descriptions of the status codes.

Note: Since the logical volumes being exported are a secondary copy, the TS7700 will allow the primary copy of a logical volume that is part of the export operation to be used for any library operation, including mounts. If a volume is mounted and modified while the copy export operation is being performed, the now invalid copy of the volume is still exported (assuming it was valid when the operation began). Whether that is reflected in the database depends on the timing of the database backup and when the volume is modified. The correct database update will be part of the next copy export operation in this case.

- The physical volumes associated with the secondary physical volume pool that have active data on them, are written in the TS7700 format and contain only secondary logical volume copies are locked for the operation and cannot be used for secondary data recovery. If a physical volume is only partially full (it has a status of filling when the operation began), its status will be changed to full as part of the copy export operation. The locked physical volumes will be processed for export.
- Any cache-resident only logical volumes to be exported are copied to the specified pool. As the logical volumes are copied, they are only copied to the physical volumes in the specified pool that were 'locked' at the beginning of the export operation. If all of those physical volumes are full, the TS7700 will use scratch physical volumes available to the pool as needed.

  Any cache-resident only logical volumes that are not part of the export operation continue to be copied to their assigned pools. For logical volumes associated with the secondary physical volume pool after the beginning of the operation, they are copied to scratch physical volumes in the pool that are not to be exported during the operation.

  Note: If scratch physical volumes are not available for the pool when one is needed during the export operation, the TS7700 will inform the host that it needs scratch physical volumes. If scratch physical volumes are not supplied within 60 minutes, the export operation is terminated and the completion code returned to the host will indicate that the export was terminated. The processed volumes remain in the library. They are not ejected or assigned to the "Export-Hold" category.
- For each of the physical volumes in the pool that have been identified to export, the following steps are performed one volume at a time:
  The physical volume is mounted and a backup of the TS7700's database is written to the volume. If the database backup could not be written to a physical volume, it cannot be exported. Status file records for all of the logical volumes on the physical volume are written indicating that the volume could not be exported because of an exported stacked volume processing error. If the export acceleration (LMTDBPVL) option was indicated, the backup will only be appended to the first two and the last two volumes exported. If less than four tapes are exported all tapes will have a backup appended to the end of the tape. These corresponding tapes containing database backup will be selected and listed in alphabetic-order of physical tape volser. In the event that the export acceleration (LMTDBPVL) option was set and there is a failure appending the DB backup, a different physical volume will be selected to contain database backup so that four physical volumes have the DB backup.
  - The status of the physical volume is marked as full (this is true even if the volume contains only a small amount of active data).
  - The state of the physical volume is changed to indicate that it has been copy-exported.
  - Status file records are generated for the active logical volumes on the physical volume.

  - Do not run host jobs that mount and write data to logical volumes which are being copy exported. If the host job mounts and writes data to logical volumes being exported while TS7700's database backup is being written to the physical volumes, the logical volumes get exposed and are only in cache.
    The status file generated later does not contain the logical volumes as they are no longer active logical volumes on the exported physical volume. But the logical volumes are marked as active in the database backup as the backup was created before the logical volumes were exposed. Inconsistency of the copy exported logical volumes occurs between the status file and the database backup written to the physical volumes.
  - The physical volume is then moved to the "Export-Hold" category, or if the EJECT option is specified in the OPTION1 record, to the eject category in the library manager associated with the TS7700 processing the export.

    Note: Prior to code level 8.4.1.57, if the EJECT option was specified and at the time the physical volume was moved to the eject category the I/O station was full; the physical volume's state is moved back to READ-WRITE even though the volume will be ejected when the I/O station has room. At code level 8.4.1.57, this is changed so that the volume maintains the copy export state and is instead moved to the Export-Hold category. At code level 8.5.0.xx, the volume remains in the eject category and is moved to the I/O station when space is available.
- In addition to the status file records for the logical volumes that have been exported, an additional group of status file records are written that provides information on all of the physical volumes in the TS7700 that have a state of copy-exported (so they include physical volumes exported during this specific export operation as well as previous ones). The information includes the current percentage of active data on each physical volume. The percentage of active data is based on the current information from the TS7700 database, not the amount when the physical volume was previously exported. This information may be used to determine when an exported physical volume should be returned to the source TS7700 because it has no active data on it. See the section on *Checking the Status of Copy Exported Physical Volumes*.
- All hosts attached to the TS7700 (or Grid) are notified that the export operation has completed. A console message is generated that includes the overall completion status of the export operation and metrics about the execution of the operation. Refer to the *Export Completion Messages* section.

Copy Export Progress Messages

During the execution of the copy export operation or a reclaim operation for a copy exported stacked volume, the TS7700 sends informational messages to its attached hosts to keep operations aware of execution progress. On z/OS hosts, the message results in a console message being written in the following format:

CBR3750I Message from library *library-name*: *message text*

Where library-name will be the distributed library name of TS7700 performing the export operation and the message text provides the progress message. The message text includes a 5 character message identifier that could be used for message automation routing. The following table describes the messages and any actions that may be required.

Note: Not all message identifiers are used.

Message Description	**Action Needed**
E0000 EXPORT OPERATION STARTED FOR EXPORT LIST VOLUME XXXXXX This message is generated when the TS7700 begins the copy export operation.	None.
E0002 OPENING EXPORT LIST VOLUME XXXXXX FAILED This message is generated when opening Export List File Volume fails during copy export operation.	Check if the Export List Volume or cache file system is in bad state or not.
E0005 ALL EXPORT PROCESSING COMPLETED FOR EXPORT LIST VOLUME XXXXXX This message is generated when the TS7700 completes an export operation.	None.
E0006 STACKED VOLUME YYYYYY FROM LLLLLLLL IN EXPORT-HOLD This message is generated during copy export operations when an exported stacked volume 'YYYYYY' has been assigned to the export-hold category. The 'LLLLLLLL' field is replaced with the distributed library name of the TS7700 performing the export operation.	Refer to section "Removing Copy Exported Volumes from a Library"
E0006 STACKED VOLUME YYYYYY FROM LLLLLLLL IN EJECT This message is generated during copy export operations when an exported stacked volume 'YYYYYY' has been assigned to the eject category **at R3.1 or lower code level**. The physical volume will be placed in the convenience I/O station. The 'LLLLLLLL' field is replaced with the distributed library name of the TS7700 performing the export operation.	Remove ejected volumes from the convenience I/O station.

E0006 STACKED VOLUME YYYYYY FROM LLLLLLLL QUEUED FOR EJECT This message is generated during copy export operations when an exported stacked volume 'YYYYYY' has been assigned to the eject category **at code level from R3.2 to R4.1.1**. The physical volume will be placed in the convenience I/O station. The 'LLLLLLLL' field is replaced with the distributed library name of the TS7700 performing the export operation.	Remove ejected volumes from the convenience I/O station.
E0006 STACKED VOLUME YYYYYY FROM LLLLLLLL IN EJECT-QUEUE This message is generated during copy export operations when an exported stacked volume 'YYYYYY' has been assigned to the eject category **at R4.1.2 or higher code level**. The physical volume will be placed in the convenience I/O station. The 'LLLLLLLL' field is replaced with the distributed library name of the TS7700 performing the export operation.	Remove ejected volumes from the convenience I/O station.
E0013 EXPORT PROCESSING SUSPENDED, WAITING FOR SCRATCH VOLUME This message is generated every five minutes when the TS7700 needs a scratch stacked volume to continue export processing and there are none available.	Make one or more physical scratch volumes available to the TS7700 performing the export operation. If the TS7700 does not get access to a scratch stacked volume in 60 minutes, the operation is terminated.
E0014 EXPORT PROCESSING RESUMED, SCRATCH VOLUME MADE AVAILABLE This message is generated when, after the export operation was suspended because no scratch stacked volumes were available, scratch stacked volumes are again available and the export operation can continue.	None.
E0015 EXPORT PROCESSING TERMINATED, WAITING FOR SCRATCH VOLUME This message is generated when the TS7700 has terminated the export operation because scratch stacked volumes were not made available to the TS7700 within 60 minutes of the first E0013 message.	Operator should make more TS7700 stacked volumes available, perform analysis of the Status file on the Export List File volume, and reissue the Export operation.
E0016 COPYING LOGICAL EXPORT VOLUMES FROM CACHE TO STACKED VOLUMES This message is generated when the TS7700 begins, and every 10 minutes during, the process of copying logical volumes which are only resident in the tape volume cache to physical volumes in the specified secondary physical volume pool.	None.

E0017 COMPLETED COPY OF LOGICAL EXPORT VOLUMES TO STACKED VOLUMES This message is generated when the TS7700 has completed the copy of all needed logical volumes from cache to physical volumes in the specified secondary physical volume pool.	None.
E0018 EXPORT TERMINATED, EXCESSIVE TIME FOR COPY TO STACKED VOLUMES The export process has been terminated because one or more cache resident only logical volumes needed for the export could not be copied to physical volumes in the specified secondary physical volume pool within a 10 hour period from the beginning the export operation.	Call for IBM support.
E0019 EXPORT PROCESSING STARTED FOR POOL XX This message is generated when the TS7700 export processing for the specified secondary physical volume pool XX.	None.
E0020 EXPORT PROCESSING COMPLETED FOR POOL XX This message is generated when the TS7700 has completed processing for the specified secondary physical volume pool XX.	None.
E0021 DB BACKUP WRITTEN TO STACKED VOLUMES, PVOL01, PVOL02, PVOL03, PVOL04 (where: PVOL01, PVOL02, PVOL03, and PVOL04 are the physical volumes the database backup was appended to) This message is generated if the copy export acceleration (LMTDBPVL) option was selected on the export.	None.
E0022 EXPORT RECOVERY STARTED The export operation has been interrupted by a TS7700 error or a power off condition. When the TS7700 has been restarted, it will attempt recovery of the operation.	None.
E0023 EXPORT RECOVERY COMPLETED The recovery attempt for interruption of an export operation has been completed.	Perform analysis of the Status file on the Export List File volume and reissue the Export operation, if necessary.
E0024 XXXXXX LOGICAL VOLUME WITH INVALID COPY ON LLLLLLLL This message is generated when the TS7700 performing the export operation has determined that one or more (XXXXXX) logical volume (s) that are associated with the secondary storage pool specified in the export list file do not have a valid copy resident on the TS7700. The 'LLLLLLLL' field is replaced by the distributed	When the export operation completes, perform analysis of the Status file on the Export List File volume to determine the logical volumes that were not exported. Ensure that they have completed their copy operations and then perform another export operation.

library name of the TS7700 performing the export operation. The export operation continues with the valid copies.	
E0025 PHYSICAL VOLUME XXXXXX NOT EXPORTED, PRIMARY COPY FOR YYYYYY UNAVAILABLE This message is generated when the TS7700 detected a migrated-state logical volume 'YYYYYY' with an unavailable primary copy. The physical volume 'XXXXXX' on which the secondary copy of the logical volume 'YYYYYY' is stored was not exported. This message is added at code level R1.7.	The logical volume and the physical volume will be eligible for the next Copy Export operation once the logical volume is mounted and demounted from the host. An operator intervention is also posted.
E0026 DB BACKUP WRITTEN TO ALL OF STACKED VOLUMES This message is generated when copy export acceleration (LMTDBPVL) option is NOT selected.	None.
E0030 STACKED VOLUME XXXXXX RETURNED TO THE LIBRARY LLLLLLLL This message is generated when Copy Exported physical volume 'XXXXXX' is inserted back to physical tape library. 'LLLLLLLL' field is replaced by the distributed library name of the TS7700 which the physical tape library is attached to. This message is added at code level R5.0.	None.
R0000 RECLAIM SUCCESSFUL FOR EXPORTED STACKED VOLUME XXXXXX This message is generated when the TS7700 has successfully completed reclaim processing for an exported stacked volume 'XXXXXX' exported during a previous copy export operation. **Note:** A copy exported physical volume can become eligible for reclaim based on the reclaim policies defined for its secondary physical volume pool or through the host console request command. This message is generated **at R4.2 or lower code level.**	The physical volume no longer contains active data so it should be returned to the library from its offsite location for re-use after the next copy export.
R0000 RECLAIM SUCCESSFUL FOR EXPORTED STACKED VOLUME XXXXXX – YOU CAN RETURN IT TO THE SPECIFIED LIBRARY LLLLLLLL This message is generated when the TS7700 has successfully completed reclaim processing for an exported stacked volume 'XXXXXX' exported during a previous copy export operation. **Note:** A copy exported physical volume can become eligible for reclaim based on the reclaim policies defined for its secondary physical volume pool or through the host console request command. This message is generated **at R5.0 or higher code level.**	The physical volume no longer contains active data so it should be returned to physical tape library which is attached to distributed library 'LLLLLLLL' from its offsite location for re-use after the next copy export.
R0001 RECLAIM UNSUCCESSFUL FOR EXPORTED STACKED VOLUME XXXXXX This message is generated when the TS7700 has attempted to reclaim an exported stacked volume exported during a previous	Obtain a list of the active logical volumes on the exported stacked volume and determine why the primary copies of them are not

copy export operation, but one or more primary copies of the active logical volumes were unavailable to complete the operation. **Note:** A copy exported physical volume can become eligible for reclaim based on the reclaim policies defined for its secondary physical volume pool or through the host console request command. **Note:** This message is not currently supported.	available to complete the reclaim.

Removing Copy Exported Volumes from the Library

Depending on the option specified in the Export List File volume, the TS7700 either has placed the copy exported physical volumes in the convenience I/O station or in the export-hold category.

If the physical volumes were placed in the I/O station during the export operation, care should be taken to make sure that only the volumes exported are moved to the offsite location or that physical volumes from more than one export operation are not mixed.

If the EJECT option was not specified, the copy exported physical volumes are retained in the physical library until an operator requests that they be ejected. To eject the volumes from the library follow the steps in Appendix A, Manage Export Hold Volumes for systems running 8.30.x.x or higher code, Appendix C\B Manage Export Hold Volumes for systems from 8.5.x.x to 8.21.x.x and Appendix C Manage Export Hold Volumes for pre 8.5.x.x systems

If the copy exported volumes that are retained in the physical library need to be returned to the library inventory then follow the steps in Appendix A Move Export Hold Volumes for systems running 8.30.x.x or higher.

Returning Copy Exported Volumes to the Library

There are two reasons for returning physical volumes that have been exported using the copy export operation to their source library. 1) They no longer contain any data and are to be re-used or 2) the primary copy of a logical volume is not accessible and the copy exported volume contains the only valid copy.

Normally, after the copy exported volumes are reclaimed; they are returned to the source TS7700 and re-used. You can identify which physical volumes can be brought back using any of the methods described in the section on *Checking the Status of Copy Exported Physical Volumes*. Once the volumes to return have been identified, you add them back to the library through the I/O station. These volumes should only be returned after the next copy export is executed and the volumes are taken off-site.

If the primary copy of a logical volume cannot be accessed because of a problem with the physical volume it was on and, in a Grid configuration, there is no other valid copy of the volume, the copy exported physical volume that contains the secondary logical volume copy must be brought back. You have several options available to identify the physical volume to return (easiest is first). 1) Use the host console request function to obtain the logical volume information. For example, say you need access to logical volume Z09866 in library PROD001 and need to bring back the copy exported physical volume it is on. Here is the information returned to the `Library Request,PROD001,lvol,Z09866` console command:

```
LOGICAL VOLUME INFORMATION V1
 LOGICAL VOLUME:               Z09866
 MEDIA TYPE:                   ECST
 COMPRESSED SIZE (MB):         792
 MAXIMUM VOLUME CAPACITY (MB): 800
 CURRENT OWNER:                PROD001
 MOUNTED LIBRARY:
 MOUNTED VNODE:
 MOUNTED DEVICE:
 TVC LIBRARY:                  PROD001
 MOUNT STATE:
 CACHE PREFERENCE:             PG1
 CATEGORY:                     1111
 LAST MOUNTED (UTC):           2007-07-02 02:06:20
 LAST MODIFIED (UTC):          2007-07-02 01:40:47
 LAST MODIFIED VNODE:          00
 LAST MODIFIED DEVICE:         30
 TOTAL REQUIRED COPIES:        1
 KNOWN CONSISTENT COPIES:      1
 IMMEDIATE-DEFERRED:           N
 DELETE EXPIRED:               N
 RECONCILIATION REQUIRED:      N
------------------------------------------------------------------------
  LIBRARY  RQ CACHE PRI PVOL  SEC PVOL  COPY ST  COPY Q  COPY CP
  PROD001   N     N   S70421    A04500     CMPT       -      DEF
```

The physical volume to be returned is shown in the ‘Sec PVOL’ field, which in this example is A04500. The other methods are to refer to the status file records when the logical volume was last exported or use of the BVIR-Volume Map function. Once you have identified the physical volume, place it in the I/O station

and on pre 8.5.x.x systems refer to Appendix C, Re-inserting Copy Export Volumes. On systems running with 8.5.x.x or higher the volume will automatically insert. The TS7700 will recognize that it owns the volume, returning it to its pool and changing its state to READ-WRITE. Since it still has active data on it, the volume status will continue to be FULL. The host job that needed the volume can now be re-run.

Note: Since you have returned the physical volume to the source TS7700, you do not have an offsite copy of the logical volumes it contains. Once the problem with the volume has been resolved, run copy export for the pool again, so that the physical volume (and any other physical volume with new data in the pool) can be moved to the offsite location.

Note: At code release level R2.1 and lower, the logical volume that you restored will be only resident in the cache on the TS7700 and will not be copied back to a physical volume in the secondary copy pool for up to 4 hours. This means that it will not be eligible for copy export during that time. At code release level R3.0 and higher, the logical volume you stored except for bad state one will remain on a physical volume in the secondary copy pool. This means that there is no need to wait for it coming to be eligible for copy export.

Note: If a physical volume is in copy export hold state and becomes empty before it is exported, at the beginning of next copy export on its pool, the empty export hold volumes will be automatically moved to scratch volumes in the pool.

Host Completion Message

At the completion of the copy export operation, a completion message is broadcast to all hosts attached to the TS7700. For z/OS, console messages are generated that provide information about the overall execution status of the operation. There are different messages depending on what the TS7700 encountered during the execution of the operation.

- If no errors or exceptions were encountered during the operation, message CBR3855I is generated. The message has the following format:

  `CBR3855I Export operation for logical list volume` *`volser`* `in library` *`library-name`* `completed successfully. Requested:` *`requested-number`* `Exportable:` *`exportable-number`* `Exported:` *`exported-number`* `Stacked volumes:` *`stacked-number`* `MBytes Exported:` *`MBytes-exported`* `MBytes Moved:` *`MBytes-moved`*

- If error or exceptions were encountered during the operation, message CBR3856I is generated. The message has the following format:

  `CBR3856I Export operation for logical list volume` *`volser`* `in library` *`library-name`* `completed with exceptions or errors. Requested:` *`requested-number`* `Exportable:` *`exportable-number`* `Exported:` *`exported-number`* `Stacked volumes:` *`stacked-number`* `MBytes Exported:` *`MBytes-exported`* `MBytes Moved:` *`MBytes-moved`*

  If message CBR3856I is generated, you will need to examine the Export Status file to determine what errors or exceptions were encountered. See the section on *Export Status File Records*.

Either of the above completion messages provides statistics on what was processed during the operation. The statistics reported are as follows:

Requested-number: The number of logical volumes associated with the secondary volume pool specified in the export list file. Logical volumes associated with the specified secondary volume pool that were previously exported are not considered part of this count.

Exportable-number: The number of logical volumes that are considered exportable. A logical volume is exportable if it is associated with the secondary volume pool specified in the export list file, it has a valid copy resident on the TS7700 performing the export. Logical volumes associated with the specified secondary volume pool that were previously exported are not considered to be resident in the TS7700.

Exported-number: The number of logical volumes that were successfully exported.

Stacked-number: The number of physical volumes that were successfully exported.

MBytes Exported: Number of Mbytes contained in the logical volumes that were successfully exported. If the data on the logical volumes is compressed, the number includes the effect of compression.

Note: The number of Mbytes exported is the sum of the Mbyte integer values of the data stored on each Exported Stacked Volume. The Mbyte integer value for each Exported Stacked Volume is the full count by byte divided by 1,048,576 bytes/Mbyte. If the result is less than 1, the Mbyte integer becomes 1, and if greater than 1 Mbyte, the result is truncated to the integer value (rounded down).

MBytes Moved: For copy export at code release level R1.3, this field reports the same number as the MBytes Exported field. For copy export at code release level R1.4 and higher, this value is 0.

- If the copy export operation was canceled either through a host command or through the library manager, message CBR3863I is generated.

  `CBR3863I Export operation cancelled for logical list volume volser in library library-name.`

  The status file created by the TS7700 subsystem on the export list file volume can be examined to determine how far the operation progressed before it was canceled. See the section on *Export Status File Records*.

- If the copy export operation was terminated because of a hardware failure in the TS7700 or Library Manager, message CBR3856I is generated. The status file created by the TS7700 subsystem on the export list file volume can be examined to determine how far the operation progressed before it terminated. See the section on *Export Status File Records*.

- If the TS7700 subsystem was unable to process the export list file volume, message CBR3858I is generated. The reason the list volume could not be processed is included in the completion message as a text string. The following table defines the failure-reasons returned, the probable cause and the recommended actions for the customer to take.

  `CBR3858I Error incurred with list volume volser in library library. Library returned failure: failure-reason.`

  In the table below, the symbols <VOLSER>, <File>, <Record> and <Field> will be replaced in the message text as appropriate to describe the location of the error found:

  - <VOLSER>, the logical Volser which was provided in the Export or Import command.
  - <File>, Export List File, Import List File, Reserved File or Status File.
  - <Record>, within a <File>, HDR1, HDR2, EOF1, EOF2, Identifier or Record.
  - <Field>, within a <Record>, Label Identifier, Block Count, Record Length, Block Count, Title Text, Option or Version.

Failure-Reason Text *Probable cause.*	**Recommended Action**
Volume <VOLSER> has not been written The Export command specified an Export List file logical Volume which has not been created (written).	Operator should check for the correct identity of the Export List File Volume and, if necessary, execute the JCL which prepares a logical volume as the Export List File Volume.
Volume <VOLSER> could not be opened TS7700 failure.	Call your IBM Service Representative
Volume <VOLSER> could not be rewound TS7700 failure	Call your IBM Service Representative
Volume <VOLSER> could not be closed TS7700 failure.	Call your IBM Service Representative

Volume <VOLSER> unable to locate Export List Records No records were found in the Export List File on the Volser specified.	Check source data used for preparation of the Export List File Volume.
Volume Label, read error Volume Label record could not be read successfully.	Call your IBM Service Representative
Volume Label, compacted Volume Label record was compacted data.	Check JCL which prepared the Export List File Volume.
Volume Label, error converting Label Identifier The EBCDIC field did not convert to ASCII correctly.	Check JCL which prepared the Export List File Volume.
Volume Label, incorrect Label Identifier The characters 'VOL1' were not found in the Label Identifier and Label Number fields of the Volume Label.	Check JCL which prepared the Export List File Volume.
Volume Label, error converting Volser The EBCDIC field did not convert to ASCII correctly.	Check JCL which prepared the Export List File Volume.
Volume Label, Volser Mismatch The Volser found in the Volume Label does not match the Volser specified in the Export command.	Call your IBM Service Representative
Volume Label, found tape mark instead Tape Mark was found which is not in the correct format sequence.	Check JCL which prepared the Export List File Volume.
Volume Label, unexpected End of Tape The End of Tape was reached unexpectedly when attempting to read the Volume Label.	Check JCL which prepared the Export List File Volume.
Volume Label, record is not 80 bytes The Volume Label record is not 80 bytes.	Check JCL which prepared the Export List File Volume.
<File> <Record>, read error When attempting to read the indicated record from the Tape Volume Cache, a read error occurred.	Call your IBM Service Representative
<File> <Record>, found tape mark instead A tape mark was read instead of the File and Record indicated.	Check JCL which prepared the Export List File Volume.
<File> <Record>, unexpected End of Tape The End of Tape was reached on the tape volume unexpectedly	Check JCL which prepared the Export List File Volume.

<File> <Record>, compacted The Record in the File indicated was compacted.	Check JCL which prepared the Export List File Volume.
<File> <Record>, error converting <Field> The EBCDIC Field in the File and Record indicated did not convert to ASCII correctly.	Check JCL which prepared the Export List File Volume.
<File> <Record>, incorrect <Field> The Field indicated in the File and Record indicated did not have the correct contents.	Check JCL which prepared the Export List File Volume.
<File> <Record>, invalid Record Length The Record Length field of the HDR2 or EOF2 record in the File indicated is not equal to 80 characters.	Check JCL which prepared the Export List File Volume.
<File> <Record>, Block and Record Length mismatch The Block Length and Record Length fields of HDR2 or EOF2 are not equal in the Record and File indicated	Check JCL which prepared the Export List File Volume.
<File> <Record>, record is not 80 bytes The length of the HDR1, HDR2, EOF1 or EOF2 record is not equal to 80 bytes in the Record and File indicated.	Check JCL which prepared the Export List File Volume.
<File>, missing a tape mark For the File indicated, a tape mark was not found as expected in the format.	Check JCL which prepared the Export List File Volume.
<File>, internal processing error MMMM TS7700 error. MMMM is a decimal number which indicates the internal functional area encountering the error.	Call your IBM Service Representative
Export List File Identifier, Unsupported Version The version specified is not supported or is undefined.	Check JCL which prepared the Export List File Volume.
Export List File volume assigned to export pool The export list file volume was found to be assigned to the pool specified for copy export. The export list file volume cannot be in the pool that is to be exported.	Ensure that the management class associated with the export list file volume is not the one that also specifies the copy export pool.
Export Version 03 or 04 and Export Parm record not found where expected When the export format version is '03' or '04', an export parameter record must	Check JCL which prepared the Export List File Volume.

follow the export list file identifier record. The record is either not present, is out of sequence or its record identifier is invalid.	
Export Parm record specifies a pool that is not exportable For copy export, the specified pool has been defined as a primary copy pool.	Check JCL which prepared the Export List File Volume.
Export would exceed maximum copy export physical volumes If the copy export operation were to continue, the number of physical volume exported would exceed the system limit of nnnn (where: nnnn is the current export volume limit).	Change the reclaim criteria so that empty physical volumes can be created and then return the physical volumes that are empty. At code level R1.6 and higher, it is possible to increase the current export volume limit above the 2000 default. Before increasing the limit, make sure that the new number of copy exported physical volumes can be placed in a library for recovery.
Export Option 1 record invalid The export option 1 record contains invalid or unknown options	Check JCL which prepared the Export List File Volume.
Reserved File, Identifier not found The Identifier record for the Reserved File was not found.	Check JCL which prepared the Export List File Volume.

Operator Interventions

At code level R1.7 operator interventions are newly added to notify customer that an error occurs. The errors are also listed in the status file in the copy export list volume.

Failure-Reason Text	**Recommended Action**
The database backup to physical volume XXXXXX failed during the Copy Export operation as a result of a media error.	During a Copy Export operation, the TS7700 encountered an unrecoverable error, indicating that the media of the stacked volume is degraded. A database backup was not written on the volume. The stacked volume was not copy exported and it was placed in READ-ONLY status. If the TS7700 determines that any stacked volumes are in READ-ONLY status, it starts a process that moves the valid logical volumes to other stacked volumes, then ejects the stacked volume from the logical library. The new stacked volumes become candidates for the next Copy Export.
A media error occurred during the Copy Export operation and the physical volume XXXXXX has been ejected. The medium may be degraded, and should not be reused in an export pool.	During a Copy Export operation, the TS7700 encountered an unrecoverable error, indicating that the media of the stacked volume is degraded. A database backup was not written on the volume. The stacked volume was not copy exported and it was placed in READ-ONLY status. If the TS7700 determines that any stacked volumes are in READ-ONLY status, it starts a process that moves the valid logical volumes to other stacked volumes, then ejects the stacked volume from the logical library. The new stacked volumes become candidates for the next Copy Export.
The Copy Export operation did not export physical volume XXXXXX because the primary copy for logical volume YYYYYY is currently unavailable.	During a Copy Export operation, the TS7700 detected a migrated-state logical volume with an unavailable primary copy. The physical volume on which the secondary copy of the logical volume is stored was not exported. This step was skipped to ensure there is continued access to this logical volume by the subsystem. The logical volume and the physical volume will be eligible for the next Copy Export operation once the logical volume is mounted to and demounted from the host.

Export Status File Records

As a copy export operation is performed, the TS7700 creates export status file records on the export status file of the export list file volume. When the operation completes (either normally, due to a terminating error or canceled) the export status file records provide information about the logical and physical volumes processed by the operation. Each status file record is 80 bytes in length and formatted in plain text using EBCDIC. There are two types of records generated, export status and physical export volumes.

Note: With the addition of the logical block IDs to the status record format, the overall format of the status records has changed. The TS7700 will update the version number on the EXPORT STATUS 01 header record written by the host to reflect EXPORT STATUS 02.

- Export Status

  Export status file records are written for each of the logical volumes that were eligible for export. The records indicate whether the volume was successfully exported or not. If it was exported, each record includes the physical volume and the starting and ending logical block ID for the logical volume. The records are sorted by physical volume, then by logical volume. The table below defines the format of the export status file records:

Bytes	Name	Description
0-5	Logical Volser	For copy export, this field contains the volume serial number of an active logical volume that has been processed as part of the operation.
6	Field Delimiter	Comma character
7-12	Physical Volser	For a successful export (status code = 00), this field contains the volume serial number of the exported stacked volume the logical volume resides. If the export was unsuccessful, this field contains all blanks. This field is right-justified and padded with blanks.
13	Field Delimiter	Comma character
14-15	Status Code	This field contains a two character status code.
16	Field Delimiter	Comma character
For an unsuccessful copy export (status code \= 00), the following fields are defined.		
17	Exception Indicator	This field contains the asterisk character.
18-78	Status Text	This field contains status text indicating the reason the export for the logical volume was not successful. This field is left-justified and padded with blanks.
For a successful copy export (status code = 00), the following fields are defined.		
17:33	Reserved	Blanks
34	Field Delimiter	Comma character
35:42	Starting Logical Block ID	For a successful copy export (status code = 00) this field contains the hexadecimal starting logical block ID on the physical volume where the logical volume is located. The number is padded with leading 0s.
43	Field Delimiter	Comma character
44:51	Ending Logical Block ID	For a successful copy export (status code = 00) this field contains the hexadecimal ending logical block ID on the physical volume where the logical volume is located. The number is padded with leading 0s.
52:79	Reserved	Blanks

For each of the logical volume records, a status code is included that specifies the completion status for the volume. The following table defines those status codes, the probable cause and the recommended actions.

Note: Status codes that are not defined in the table are reserved for future use.

Operation Status	Resolution Actions
Status Code ’00’ ***Status Text*** For Copy Export, see the export status record field definitions. ***Probable Cause*** The volume was successfully exported.	None needed.
Status Code ’02’ ***Status Text*** 'Canceled - Host request’ ***Probable Cause*** The volume could not be processed because the operation was canceled by the host prior to processing the volume.	Determine why the operation was canceled and retry it.
Status Code ’03’ ***Status Text*** 'Canceled - Library request’ ***Probable Cause*** The volume was not processed because the operation was canceled, prior to processing the volume, by the operator through the Library Manager console.	Determine why the operation was canceled and retry it.
Status Code ’10’ ***Status Text*** ‘Terminated by library error’ ***Probable Cause*** The volume could not be processed because the operation was terminated by a non-recoverable (check1) error detected by the Library Manager prior to processing the volume.	Call an IBM Service Representative.
Status Code ’11’ ***Status Text*** ‘Terminated by error XXXX ’ ***Probable Cause*** The volume could not be processed because the operation was terminated by a non-recoverable error detected by the TS7700 prior to processing the volume.	Call an IBM Service Representative. Error XXXX indicates the functional area within the TS7700 which encountered the non-recoverable error.

Status Code ’16’ ***Status Text*** 'Stacked Volume access failure’ ***Probable Cause*** For Export, the logical volume could not be exported because the TS7700 stacked volume containing the logical volume is written in a pre-TS7700 format or could not be accessed.	1. Check whether the physical volume is written in the pre-TS7700 format using one of the methods described in section *Copy Export Operation* regarding pre-execution checking. If the physical volume’s format is not TS7700, the logical volumes must be converted to the new TS7700 format. 2. On pre 8.5.x.x systems, refer to “Using the Search Database for Volumes Window” in the 3494 or 3953 Operator Guide. For the volser indicated, if the Status Flags are Inaccessible or Misplaced, follow instructions in the “Problem Determination with the Search Database for Volumes Window” section of the operators guide. 3. On 8.5.x.x and higher systems, for the volser indicated perform a Physical Volume Search from the MI panel. Refer to the Info Center for options with this panel. 4. If the volser Status Flags are other than Inaccessible or Misplaced, call an IBM Service Representative.
Status Code ’19’ ***Status Text*** ‘Logical Volume Copy Failure’ ***Probable Cause*** The logical volume could not be exported because it is currently resident in the tape volume cache and attempts to copy it to a stacked volume failed.	Call an IBM Service Representative.
Status Code ’1A’ ***Status Text*** ‘Logical Volume TVC State Unknown’ ***Probable Cause*** The logical volume could not be exported because its state in the Tape Volume Cache could not be determined.	Call an IBM Service Representative.

Status Code '1B' ***Status Text*** 'Logical Volume Processing Error XXX' ***Probable Cause*** The logical volume could not be processed because an internal VTS/TS7700 error XXX was encountered. Code Functional Area 132 Physical volume processing 151 Physical volume processing 367 Migration processing	Call an IBM Service Representative. Error XXX indicates the functional area within the TS7700 which detected the internal error.
Status Code '20' ***Status Text*** 'Library Manager Error' ***Probable Cause*** The logical volume could not be exported because of a library manager reported error during export processing.	Call an IBM Service Representative.
Status Code '21' ***Status Text*** 'Terminated - out of scratch' ***Probable Cause*** The logical volume could not be processed because the operation was terminated after waiting 60 minutes for a scratch stacked volume to be made available to the TS7700.	1 Add scratch physical volumes to the TS7700. 2. Retry the operation.
Status Code '26' ***Status Text*** 'Terminated, too few physical drives available' ***Probable Cause*** The volume could not be processed because the operation was terminated because the number of available drives for each installed drive type was less than four when the operation was initiated or became fewer than four during the execution of the operation.	Call an IBM Service Representative

Status Code '28' ***Status Text*** 'Exported Stacked Volume processing error' ***Probable Cause*** On a copy export, a copy of the database backup could not be written to the exported stacked volume.	Suspected media failure, database backup creation error, tape drive failure, or any other internal error, call an IBM Service Representative. At code level R1.7 and higher, if TS7700 detects that the media of the stacked volume is degraded, the logical volumes on the stacked volume are automatically moved to a new stacked volume and the degraded stacked volume is ejected. Operator interventions are also posted.
Status Code '3C' ***Status Text*** 'Valid logical volume not on exporting TS7700' ***Probable Cause*** The logical volume associated with the secondary storage pool specified as part of a copy export operation could not be exported because it does not have a valid copy on the TS7700 performing the export, even though the management class assigned to the volume did include that TS7700 as having a copy. Either the copy had not completed prior to the start of the export operation or the source TS7700 is unavailable.	Verify that all TS7700s in the Grid are operational and retry the export operation. If all are operational wait until all copies are complete and then retry the export operation.
Status Code '3D' ***Status Text*** 'Physical volume contains primary data' ***Probable Cause*** The logical volume resides on a physical volume in a secondary storage pool specified as part of a copy export operation, but that physical volume could not be exported because it contains one or more primary logical volumes.	See the action for code 3E

Status Code '3E' ***Status Text*** 'Primary logical volume on secondary pool volume' ***Probable Cause*** The logical volume is a primary logical volume but it is resident on a physical volume associated with the secondary storage pool specified as part of a copy export operation. The physical volume could not be exported. This is likely the result of a prior error in recalling the original primary volume and a swap was performed to make the copy on the secondary pool the primary volume. (Obsolete – refer to Status Code '40' below)	Force a recall of the logical volume. This will cause it to be re-migrated to new primary and secondary volumes so that it can be exported.
Status Code '3F' ***Status Text*** 'Physical volume contains sole accessible data' ***Probable Cause*** The logical volume resides on a physical volume in a secondary storage pool specified as part of a copy export operation, but that physical volume could not be exported because it contains one or more logical volumes that are the sole accessible copy of a volume. Also read the probable cause description for status code 40. **Note:** Status codes 3F and 40 were introduced at code level 8.5.0.xx	See the action for code 40
Status Code '40' ***Status Text*** 'Primary logical volume on secondary pool volume' ***Probable Cause*** The logical volume which is resident on a physical volume associated with the secondary storage pool specified as part of a copy export operation is only an accessible one. The physical volume could not be exported. This is likely the result of a prior error in recalling the logical volume from a physical volume in a primary pool. The only accessible copy of the logical volume is now on a physical volume in the secondary volume pool.	Force a recall of the logical volume. This will cause it to create a new copy on a physical volume in the primary volume pool so that it can be exported.

Status Code '41' ***Status Text*** 'Unsupported Media with data not allowed in copy export pool' ***Probable Cause*** Unexportable filling or full sunset media physical volume exists in the secondary storage pool specified as copy export pool by copy export operation. In this case, copy export operation fails and no physical volume is exported.	At code level R2.1 and higher, copy export detects unexportable sunset media in association with E07 drive support. Look at the table in page 15 and check if all physical volumes which exist in the copy export pool are exportable in current environment. If there is an unexportable physical volume, it is necessary to make it empty by Move Virtual Volumes, etc.

- Physical Export Volumes

  In addition to the status records regarding the logical volumes processed, there is a second set of records written to the export status file that provides information about the current status of all physical volumes in the TS7700 that have a volume state of copy-exported. The records are sorted by the percent utilized for active data, lowest to highest. For records that have the same percentage of utilization, they are further sorted by pool number, then volser. The table below defines the format of the physical export volume records. DB Backup Indicator field is applied only for 8.21.x.x. or later.

Bytes	Name	Description
0-5	Physical Volume	This field contains the volume serial number of a physical volume, with a volume access status of Copy Exported.
6-7	Field Delimiter	Blank characters
8-9	Pool	This field contains the pool the physical volume is assigned to. For pool number 1 through 9, the value is right justified and padded with a blank.
10-11	Field Delimiter	Blank characters
12	Recording Format	This field identifies the recording format used to write the physical volume. The following values are defined for this field: '4' : 3592 model J1A '5' : 3592 model E05 '6' : 3592 model E05E (encryption) '7' : 3592 model E06 '8' : 3592 model E06E (encryption) '9' : 3952 model E07 'A': 3952 model E07E (encryption) 'B' : 3952 model E08 'C': 3952 model E08E (encryption)
13-14	Field Delimiter	Blank characters
15-22	Total Bytes Written	This field contains a count of the number of megabytes written to the volume when it was marked as full, rounded up to the nearest MB. The value is right justified and padded with blanks. It is set to 0 when the volume no longer has any active data on it.

		Note: 1. This value may be significantly less than the potential capacity of the physical volume. When copy export is executed, any physical volume with any amount of active data on it in the pool being exported is marked full and exported. 2. Starting with the TS7700 code release level R3.3, this field expanded from bytes 15-21 to bytes 15-22. Subsequent fields are shifted down by 1 byte.
23-24	Field Delimiter	Blank characters
25-28	Percentage Utilized	This field reports the percentage of total active data size and total bytes written, when the volume was marked full, that are currently utilized for the valid logical volumes on the physical volume. Over time, the amount of valid data on an exported physical volume will decrease. The value reported is in 1/10th of a percent, rounded up to the nearest 1/10th of a percent. The value is right justified and padded with blanks. It is set to 0 when the volume no longer has any active data on it. **Note:** The utilization is not based on the potential capacity of the physical volume but the amount of data on the volume when it was marked as full (Total Bytes Written).
29-30	Field Delimiter	Blank characters
31	Media Type	This field identifies the media type of the physical volume. The following values are defined for this field: ‘5’: JA Media ‘6’: JJ Media ‘7’: JB Media ‘8’; JC Media ‘9’: JK Media ‘A’; JD Media ‘B’: JL Media
32-33	Field Delimiter	Blank characters
33-52	Exported Timestamp	This field indicates the date and time that the physical volume was exported. The format of the timestamp is: Year-Month-Day-Hour.Minute.Second for example: 2006-05-23-19.34.23
53-54	Field Delimiter	Blank characters
55	DB Backup Indicator	This field indicates the pvol has valid DB backup data which can be used at copy export recovery process. The following values are defined for this field: ‘0’: This pvol does not have valid DB backup data. ‘1’: This pvol has valid DB backup data.
56-79	Blank	Blank characters

The physical volume export records are preceded by a header record that identifies the fields. That record is formatted as described in the table below:

Bytes	Name	Description
0-3	Physical Volume Header	'#VOL'
4-5	Field Delimiter	Blank characters
6-9	Pool Number Header	'POOL'
10	Field Delimiter	Blank character
11-12	Recording Format Header	'FM'
13-15	Field Delimiter	Blank characters
16-21	MBytes Written Header	'MBYTES'
22-23	Field Delimiter	Blank characters
24-27	Percentage Utilized Header	'%UTL'
28	Field Delimiter	Blank character
29-31	Media Type Header	'MED'
32	Field Delimiter	Blank character
33-50	Exported Timestamp Header	'COPY EXPORTED TIME'
51-52	Field Delimiter	Blank character
53-54	DB Backup Indicator	'1'
55-79	Blanks	Blank character

Canceling a Copy Export Operation

There are several reasons for canceling an export operation:

- After being initiated, you may realize that the pool being processed for export was incorrect.
- Other more critical workload is required to be run on the TS7700 and the extra overhead of running the export operation is not desired.
- A problem is encountered with the export that cannot be quickly resolved, for example there are no physical scratch volumes available to add to the library.
- A problem is encountered with the library that requires it to be taken off-line for service.

An export operation can be canceled from a host or through the library manager console for pre 8.5.x.x systems or on the TS7700 on systems running 8.5.x.x code and higher.

A request to cancel an export operation can be initiated from any host attached to the TS7700 subsystem using one of the following methods:

- Host console command: LIBRARY EXPORT,XXXXXX,CANCEL - where XXXXXX is the volume serial number of the Export List File Volume.
- Program Interface using the Library Control System (LCS) external services CBRXLCS.

For pre 8.5.x.x systems, if an export operation must be canceled and there is no host attached to the TS7700 that can issue the cancel command, you can cancel the operation through the library manager console. Select the Cancel VTS Export/Import item from the commands pull-down and then select an active export operation from the dialog box displayed. After confirming the selection, the library manager sends the cancel request to the TS7700 processing the copy export operation.

Regardless of whether the cancel is originated from a host or the library manager, the TS7700 will process it as follows:

- If processing of a physical volume has reached the point where is has been mounted to receive a database backup, the backup will complete and the volume placed in the export-hold or eject category before the cancel processing can be continued. Status file records are written for all logical and physical volumes which completed export processing.
- All physical resources: drives, stacked volumes and exported stacked volumes, are made available for normal TS7700 subsystem processing.
- A completion message is sent to all hosts attached to the TS7700 indicating that the export was canceled via a host request. The message contains information about how much export processing completed prior to the execution of the cancel request.

You should examine the export status file records to see what had been processed prior to the cancel request. Any physical volumes that completed the export process should be processed as if the export operation had completed.

Planning and Considerations for the Recovery TS7700 and Library

There are several things that you will need to consider in planning a recovery TS7700 for the copy export volumes. There are two types of recovery from copy exported tapes. There is a customer initiated recovery that restores copy exported tapes to a stand-alone TS7740 for DR testing or as a recovery site. Beginning with R1.7, the same subset of tapes can be used to restore a TS7740 in an existing grid so long as the new empty restore cluster is meant to replace the no longer present source cluster. This allows data that may have existed only within a TS7740 within a Hybrid configuration to be restored while maintaining access to the still existing TS7720 clusters. This form of extended recovery must be carried out by support personal. Only the standard export recovery to a stand alone TS7740 can be executed by the customer. This document covers the customer initiated recovery.

The stand-alone TS7700 and associated library that is to be used for recovery of the copy exported logical volumes must meet the following requirements:

- It must have physical tape drives that match the capabilities of the source TS7700, including encryption capability if the copy exported physical volumes have been encrypted.
- If the source copy exported volumes have been encrypted, the recovery TS7700 must have access to a key manager that has the encryption keys for the data.
- There must be sufficient library storage slots in the library associated with the recovery TS7700 to hold all of the copy exported physical volumes from the source TS7700.
- Only the copy exported volumes from a single source TS7700 can be used in the recovery process.
- The recovery TS7700 cannot be part of a Grid configuration.
- The recovery TS7700 must be configured as cluster 0.
- The TS7700 and its associated library manager must be configured, have code loaded and be in an online state to start the recovery.
- On pre 8.5.x.x systems with dual library managers configured, they must both be online and operational to perform the recovery operations.
- On pre 8.5.x.x systems ensure that Service Access is enabled on the library manager. If dual library managers are configured, ensure that it is enabled on both library managers. Service access is required to allow the TS7700 to manage the library manager inventory records during copy export recovery. To enable Service Access, go to the **Commands** pull down on the library manager, then select **Service Access**, then **Enable Service Access**. To ensure the access is working, Service Access should be disabled (on the same panel), wait thirty (30) seconds, and then enable service access.
- If the recovery TS7700 is not empty of data (in cache or the database), the copy export volumes must not be loaded into the attached library until the machine has been emptied of data. The procedures detailed in the next section will identify when the physical volumes need to be loaded into the library as well as how to empty the TS7700 of data.
- The code level on the recovery TS7700 and on its associated library manager must be at the same or higher code level as the source TS7700.
- At 8.41.2xx.x or higher code level, new compression methods (LZ4 and ZSTD) are supported. However, it is not needed to care about if logical volumes on copy-exported physical volumes are compressed by new compression method or not because the code levels on the recovery TS7700 must be at the same or

higher code level as the source TS7700. The recovery TS7700 must be able to read compressed logical volumes.

- Physical volumes which were exported prior to installing 8.41.200.113 or higher code level can utilize the SMS DITTO tool to recover logical volume content stacked on a physical tape using a z/OS attached IBM TS1100 based native tape control unit. The following link describes the process. https://www.ibm.com/support/knowledgecenter/en/SSLTBW_2.1.0/com.ibm.zos.v2r1.idarc00/vtcrec.htm
- Beginning with release 8.41.200.113, the internal logical volume format of the TS7700 has changed and therefore the SMS DITTO tool can no longer be used. DITTO can continue to be used for logical volumes created prior to installing 8.41.200.113, but any logical volumes created after installing 8.41.200.113 or later that are stacked to physical tapes are not accessible through DITTO. The TS7700 will begins creating logical volumes with the new format once all clusters in a grid are running 8.41.200.113 or later or it's a stand alone cluster running 8.41.200.113 or later.
- On pre 8.5 systems or systems with 3494 attached libraries, if there is another VTS/TS7700 or native drives on the other partition of the library manager, it must not have any volsers that overlap with the volsers to be recovered. This includes both logical and physical volumes. If any conflicts are encountered during the recovery process, the volsers that conflict will not be recovered and a warning message will be displayed in the recovery status panel on the recovery TS7700 management interface. This also means that you cannot use the same library for both the source and recovery TS7700.
- On pre 8.5 systems or systems with 3494 attached libraries, if there is another VTS/TS7700 or native drives on the other partition of the library manager, it must not use the same Data Class, Storage Class, Management Class or Storage Group names that were defined on the source TS7700 if the actions for the names are different. As part of the copy export recovery process, the storage construct names and their definitions from the recovered database will be loaded into the library manager database. If the same construct name is already defined, it actions will be replaced by the actions from the source TS7700.
- On systems running 8.5 and higher with a 3584 attached libraries, if there are other logical partitions on the 3584 library, the physical volumes in the other partitions must not overlap with the volsers to be recovered. This also means that you cannot use the same library for both the source and recovery TS7700.
- Other than the physical drive compatibility requirements listed above, the source and recovery TS7700 can have a different configuration of features, ie different cache capabilities, performance enablement features, etc..
- Setting “TVCWDEG=EQUAL or LOWER” and “PRETHDEG=DISABLE” by LI REQ “SETTING2, PHYSLIB” to copy export recovery cluster is recommended to prevent workloads from stopping due to Physical Library degraded state such as out of scratch state. Regarding TVCDEG, setting DISABLE should be avoided. Even though the cluster enters out of scratch state, read from tape and write to CP0 still work without changing PHYSLIB settings. However, once writing data to CPx is tried, it enters in trouble.
- You will need to add scratch physical volumes to the recovery TS7700 even if you are only going to be reading data. A minimum of 2 scratch volumes per defined pool in the TS7700 is needed to prevent the TS7700 from entering the out of scratch state. In the out of scratch state, logical volume mounts are not allowed. When adding scratch physical volumes to the recovery TS7700, do so only after the recovery has been performed and the recovery TS7700 is ready to be brought online to its attached hosts,

otherwise their inventory records will have been erased during the recovery process. Physical volumes that are part of copy export set and are now empty can not be counted as scratch.

- To shorten the time it takes to execute copy export recovery, it is recommended that after a recovery test; perform the erasure portion of copy export recovery. This may also eliminate logical volume overlap issues when two TS7700s used for recovery testing are attached to the same library manager. It is also useful to perform the erasure portion of copy export recovery if the TS7700 is subsequently going to be used for new workloads and not for disaster recovery anymore.
- After you have completed performing copy export recovery and the TS7700 is online to its hosts, you will need to insert logical volumes to be used as scratch volumes before you can write new data.
- If the recovery is for a real disaster (rather than just a test), you will want to verify that the actions defined for the storage management constructs that were restored during the recovery are what you want to continue to use.

Performing Copy-Export Recovery

Hopefully, the primary reason to perform the copy export recovery process is as part of a disaster recovery test. The recovery process, by default, assumes the reason for its execution is for test and allows the secondary logical volumes that are on the copy exported stacked volumes to be accessed without the TS7700 attempting to copy logical volumes to follow differences between the pool values in the database and the current definitions for storage group and management class constructs associated with the volumes. In addition, reclamation is suspended so that the data on the copy exported physical volumes are not modified or moved during the test. If the recovery process is part of a real disaster recovery, then an option is provided to have the TS7700 follow the normal storage management processes defined by the storage management constructs and also reclaim physical volumes as they become eligible. You select the option to run copy export recovery for testing through the management interface (MI) panel that initiates the recovery process.

To recover access to the data exported with copy export, an empty TS7700 attached to a library with sufficient physical space to contain all of the physical volumes exported from the source TS7700 is required. The physical tape drives must be compatible with the source TS7700, including encryption. The exported volumes can be from more than one pool in the source TS7700, but only the data from one source TS7700 can be restored at a time. If the recovery TS7700 contains any data (which could be from a previous test), a separate pass through the recovery process will be required to delete any data as well as database records in the TS7700 and the associated library manager partition.

The copy export recovery operation is initiated through the management interface on the TS7700. In the following steps, it is assumed that the recovery TS7700 does contains data from a previous usage for recovery or other testing. If it does not contain any data, the steps would begin with step 7.

Note: In the following steps, only the specific portion of the management interface window relating to the step is shown.

Note: Do not add the copy exported physical volumes into the library until instructed to during the recovery process. Do not add scratch physical volumes into the library until the copy export recovery has completed and the recovery TS7700 is ready to be brought online to the attached hosts.

1. With the TS7700 and library in its online state, but with all virtual tape drives varied offline to any attached hosts, login to the management interface and then select **Copy Export Recovery** from **Service** (at code level 8.30.x.x or higher) or **Copy Export Recovery** from the **Service & Troubleshooting** (at code level from 8.5.x.x to 8.21.x.x) menu as shown below:

(MI page of code level 8.30.x.x or higher)

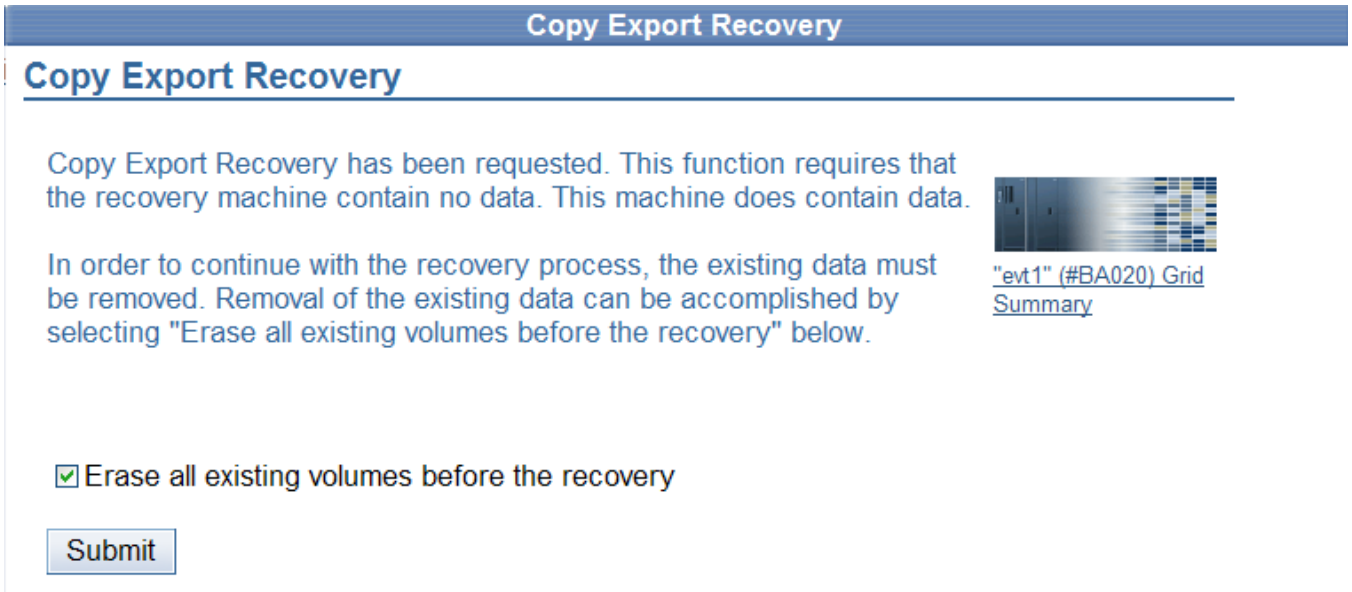
(MI page code level from 8.5.x.x to 8.21.x.x)

Note: You will only see the Copy Export Recovery menu item if you have been given access to that function by the overall system administrator of the TS7700. It is also not displayed if the TS7700 is configured in a Grid configuration.

2. The TS7700 determines that data exists in the cache and there are database entries. Copy export recovery cannot be performed until the TS7700 is empty. The following page will be displayed informing the

operator that the TS7700 contains data that must be erased.

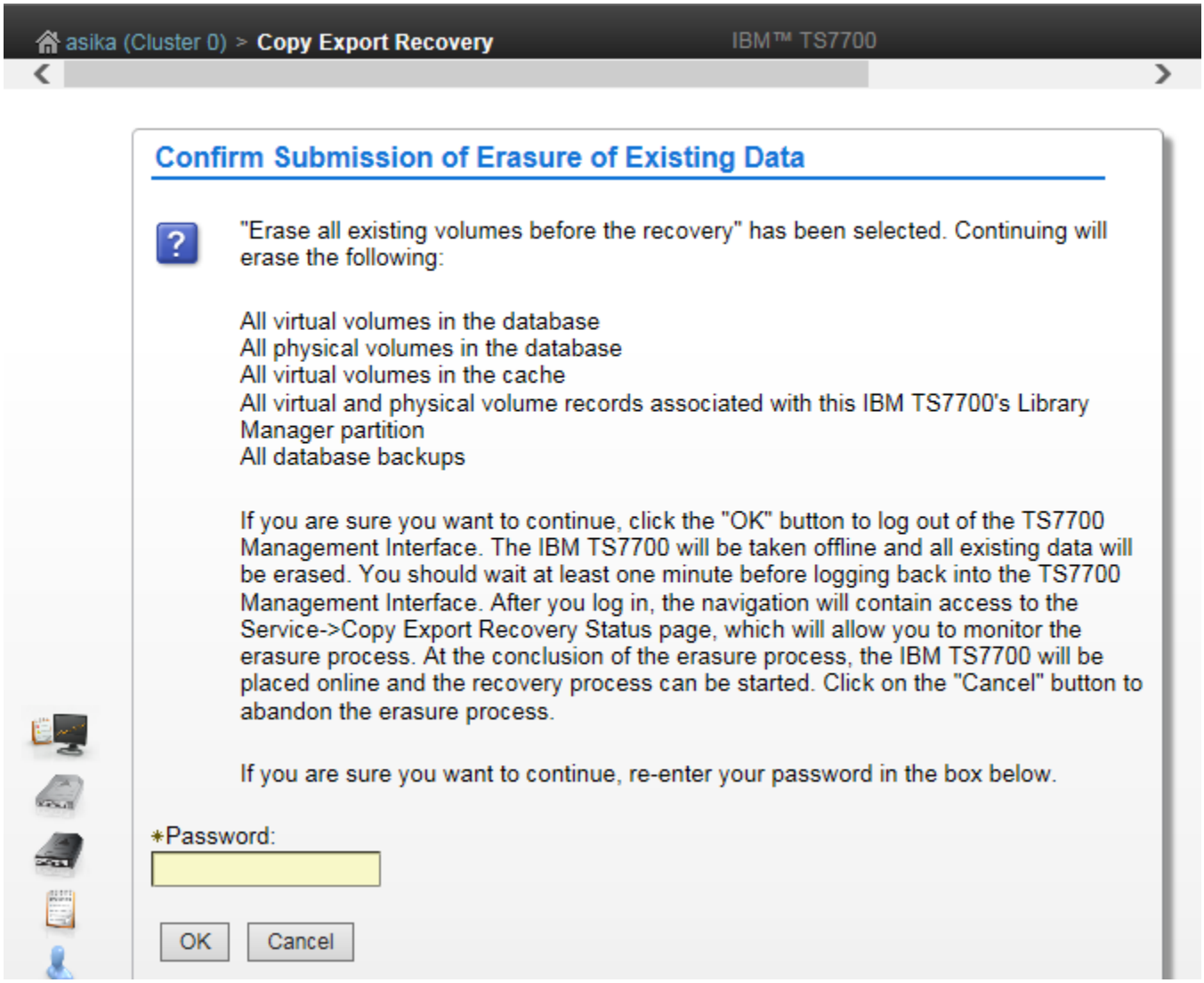
(MI page of code level 8.30.x.x or higher)



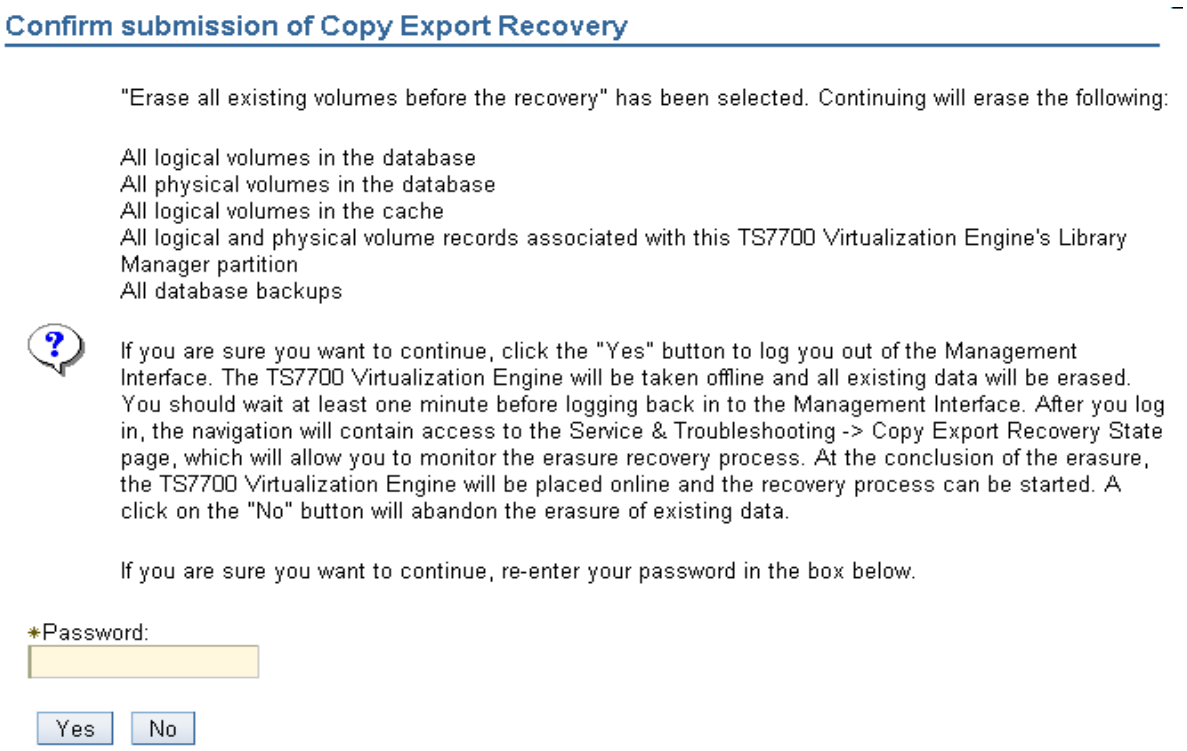
(MI page of code level from 8.5.x.x to 8.21.x.x)

3. You would ensure that you are using the correct TS7700 (check to make sure you are logged in to the correct TS7700) and if so, check the Erase all existing volumes before the recovery check box and click on the **Submit** button. In the next step you will have the option to continue with the erasure of all data or abandon the recovery process.

4. The following page is then displayed, providing you the option to confirm and continue the erasure of data on the recovery TS7700 or to abandon the recovery process. It describes what data records are going to be erased and informs you of the next action to be taken. To continue on to erase the data, enter your login password and click on the **OK** (at code level 8.30.x.x or higher) or **Yes** (at code level from 8.5.x.x to 8.21.x.x) button.



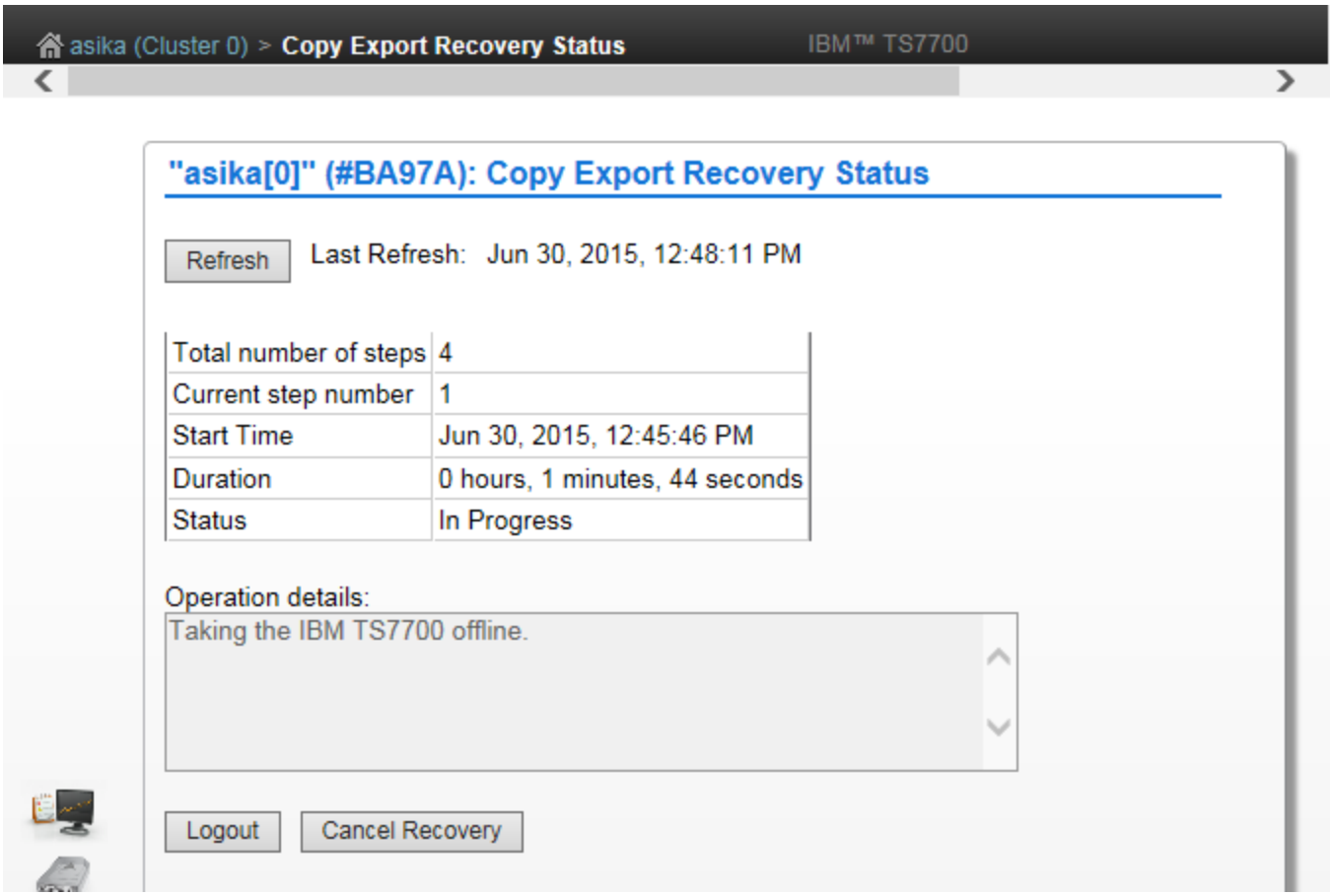
(MI page of code level 8.30.x.x or higher)



(MI page of code level from 8.5.x.x to 8.21.x.x)

5. The TS7700 will begin the process of erasing the data and all database records. As part of this step, you will be logged off from the management interface.

6. After waiting about 1 minute, login to the management interface. Because the TS7700 is performing the erase process, the only selection that will be available through the **Service** (at code level 8.30.x.x) or **Service & Troubleshooting** (at code level from 8.5.x.x to 8.21.x.x) menu is the **Copy Export Recovery Status** (at code level 8.30.x.x) or **Copy Export Recovery State** (at code level from 8.5.x.x to 8.21.x.x) page. Select that page to follow the progress of the erase process. The page provides information about the process including the total number of steps required, the current step, when the operation was initiated, run duration and overall status. An example of the page is shown below:



(MI page of code level 8.30.x.x or higher)

(MI page of code level from 8.5.x.x to 8.21.x.x)

Note: To update the page, you will need to click on the **Refresh** button.

Note: You can logoff from the management interface using the **Logout** button. Logging off from the management interface does not terminate the erasure process. You can log back into the management interface at a later time and if the erasure process is still in progress, the page will provide the latest status. If the process had completed, the **Copy Export Recovery State** menu item is not available.

The following are the tasks that will be listed in the task detail window as the erasure steps are being performed:

- Taking the TS7700 offline.
- The existing data in the TS7700 database is being removed.
- The existing data in the TS7700 cache is being removed.
- The existing data in the library partition associated with this TS7700 is being removed (Only on pre 8.5.x.x systems and 3494 attached libraries).
- Cleanup (removal) of existing data.
- Requesting the TS7700 go online.
- Copy Export Recovery database cleanup is complete.

If an error occurs during the erasure process, the task detail window will indicate the reason. The following table lists the possible error texts and the recommended action:

Text	**Action**

The TS7700 failed to go offline in the allotted time.	Retry the operation, if it still fails, call IBM Support
Library Manager data was not successfully deleted.	1) First ensure that Service Access has been enabled on the library manager. Retry. If still unsuccessful call IBM Support
Error clearing existing data from the TS7700 cache.	Call IBM Support
Error clearing existing data from the TS7700 database	Call IBM Support

Once the erase process has completed, the TS7700 will return to its online state and you can continue with copy export recovery.

7. Starting with an empty TS7700, there are several set-up tasks you will need to perform using the library manager associated with the recovery TS7700 (for many of these tasks you may only need to verify that the settings are correct; the setting are not deleted as part of the erasure step):

- Verify or define the volser range(s) for the physical volumes that are to be used for and after the recovery. The recovery TS7700 must know what volser range(s) it is to consider it owns. The steps used to define volser range(s) can be found in Appendix A – Volser Range Definition for systems running 8.30.x.x or higher code, Appendix B – Volser Range Definition for systems from 8.5.x.x to 8.21.x.x and Appendix C – Volser Range Definition for pre 8.5.x.x systems. Systems running 8.5.x.x with 3494 attached libraries must define the ranges on the 3494 also per Appendix C.
- If the copy exported physical volumes were encrypted, you must set up the recovery TS7700 for encryption support and have it connected to an external key manager that has access to the keys used to encrypt the physical volumes. If you are going to write data to the recovery TS7700, you must also define the pools to be encrypted and set-up their key label(s).
- If you are executing the copy export recovery operations to be used as a test of your disaster recovery plans and have left the “Disaster Recovery Test Mode” checkbox checked, the recovery TS7700 will not perform reclamation.

  If you are running copy export recovery due to a real disaster, then redefine the physical volume pools by following the procedures found in Appendix A – Manage Physical Volume Pool Properties for systems running 8.30.x.x or higher code, Appendix B – Management Storage Pool Properties for systems from 8.5.x.x to 8.21.x.x and Appendix C – Management Storage Pool Properties for pre 8.5.x.x systems.

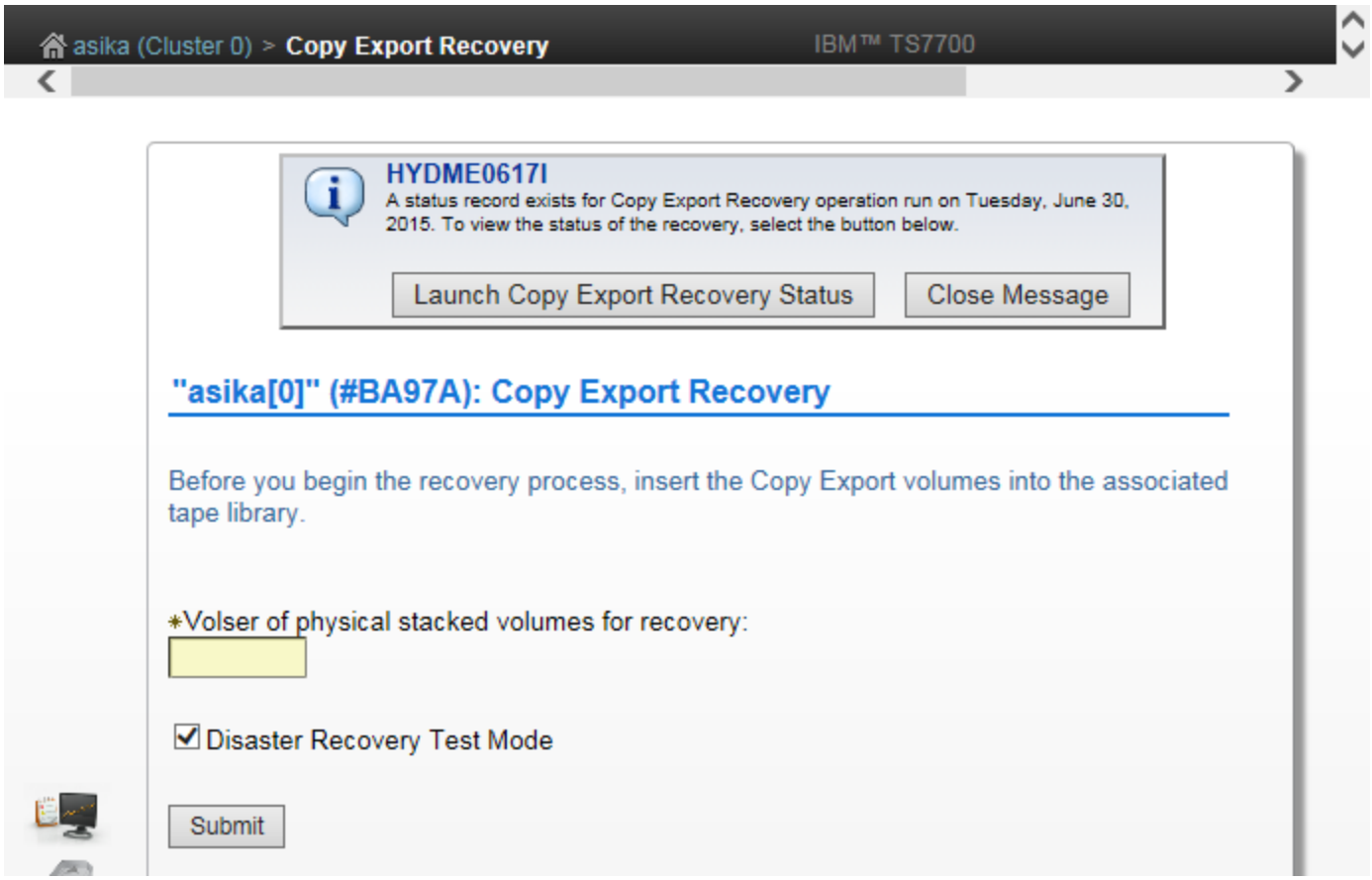
8. With the TS7700 in its online state, but with all virtual tape drives varied offline to any attached hosts, login to the management interface and then select **Copy Export Recovery** from the **Service** menu (at code level 8.30.x.x or higher**)** or **Copy Export Recovery** from the **Service & Troubleshooting** menu (at code level from 8.5.x.x to 8.21.x.x) as shown below:

(MI page of code level 8.30.x.x or higher)

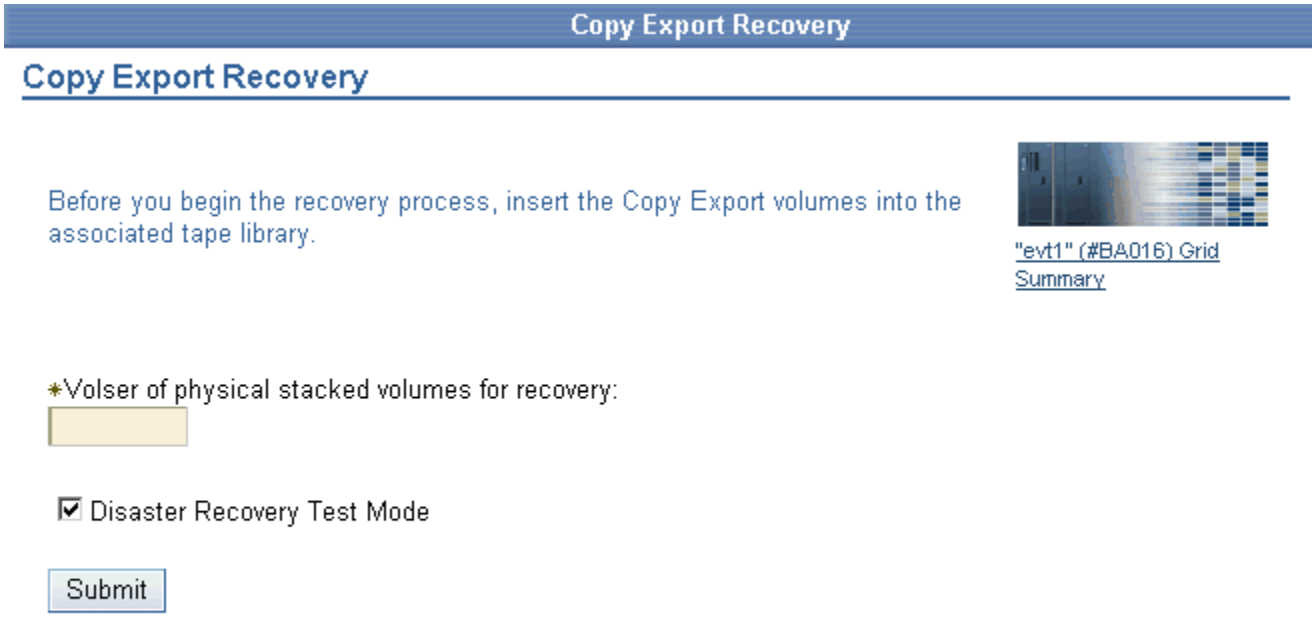
(MI page of code level from 8.5.x.x to 8.21.x.x)

Note: You will only see the Copy Export Recovery menu item if you have been given access to that function by the overall system administrator of the TS7700. It is also not displayed if the TS7700 is configured in a Grid configuration.

9. The TS7700 determines that it is empty and displays the following page:



(MI page of code level from 8.30.x.x or higher)



(MI page of code level from 8.5.x.x to 8.21.x.x)

At this point, load the copy exported physical volumes into the library. It is likely that there are multiple sets of physical volumes that have been exported from the source TS7700 over time. All of the exported stacked volume from the source TS7700 must be loaded into the library. If multiple pools were exported and you want to recover with the volumes from these pools, load all sets of the volumes from these pools. Just be sure the volser you provided is from the latest pool that was exported as it will then have the latest overall database backup copy.

Note: You need to make sure that all of the copy exported physical volumes to be used in the recovery have been added to the library prior to continuing with the recovery process. This means that they must have been recognized by the library and are now known by the TS7700. One way to check is to use the search library manager database function on pre 8.5.x.x systems and systems with a 3494 library attached. On 8.5.x.x and higher systems, choose the Physical Volumes Search panel from the MI. For example, if you had 73 physical volumes that were marked copy exported, you would see that all 73 volumes are in the database. Any volumes not added to the library will be flagged as manually ejected.

Note: If your library is a 3494 and you had already loaded the copy exported physical volumes in to the library prior to beginning the recovery process and had executed the erasure step, all of the physical volume database records for the library partition associated with the recovery TS7700 will have been erased. You will need to perform a re-inventory operation on the library to restore those records before proceeding.

Note: Do not add any physical scratch volumes at this time, do that after the copy export recovery operation has completed and you are ready to bring the recovery TS7700 online to its attached hosts.

Note: If you specified the copy export accelerator option (LMTDBPVL) when performing the export, only a subset of the tapes that were exported will have a valid database backup that can be used for recovery. If a tape that is selected for recovery does not have the backup the user will get the following error: “The database backup could not be found on the specified recovery volume”.

Once you have added all of the physical volumes into the library and they are now known to the TS7700, you use the above page to enter the volume serial number of one of the copy exported volumes from the last set exported from the source TS7700 that has a valid backup. It will contain the last database backup copy and that will be used to restore the recovery TS7700’s database. The easiest place to find a volume to enter is from the status file records on export list file volume from the latest copy export operation.

If you are using copy export recovery to perform a disaster recovery test, you will likely want to leave the “Disaster Recovery Test Mode” checkbox checked. The normal behavior of the TS7700 storage management function, when a logical volume in the cache is unloaded, is to examine the definitions of the storage management constructs associated with the volume. If the volume had been written to while it was mounted, the actions defined by the storage management constructs are applied. If the volume had not been modified, actions are only taken if there has been a change in the definition of the storage management constructs since the last time the volume was unloaded. For example, if a logical volume is assigned to a storage group which had last had the volume written to pool 4 and either the storage group was not explicitly defined on the recovery TS7700 or specified a different pool, on the unload of the volume, a new copy of it will be written to the pool determined by the new storage group definition, even though the volume was only read. If you are just accessing the data on the recovery TS7700 for a test, you would not want the TS7700 to recopy the data. Leaving the checkbox checked causes the TS7700 to bypass its checking for a change in storage management constructs.

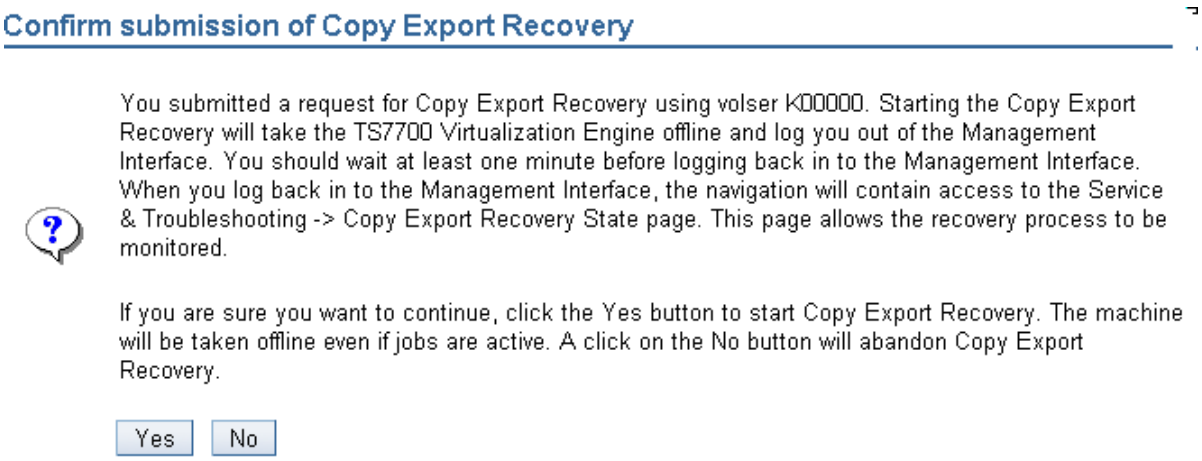
Another consideration with just running a test is reclamation. Running reclamation while performing a test will require scratch physical volumes and expose the copy exported volumes to being re-used once reclaimed. By leaving the “Disaster Recovery Test Mode” checkbox checked, reclaim is not performed.

With the “Disaster Recovery Test Mode” checkbox checked, the physical volumes used for recovery maintain their status of COPY-EXPORTED. This is so they cannot be re-used or used in a subsequent copy export operation. If you are using copy export recovery due to a real disaster, you should uncheck the checkbox and also read the section on *Creating a New Primary/Secondary Copy after Disaster Recovery*.

Once you have entered the volume serial number and decided on the checkbox, click on the **Submit** button. In the next step you will have the option to continue with the recovery or abandon it.

10. The following page is then displayed. It indicates the volume that is to be used to restore the database from. If you want to continue with the recovery process, click on the **OK** (at code level from 8.30.x.x or higher) or **Yes** (at code level from 8.5.x.x to 8.21.x.x) button. To abandon the recovery process, click on the **Cancel** (at code level from 8.30.x.x or higher) or **No** (at code level from 8.5.x.x to 8.21.x.x) button.

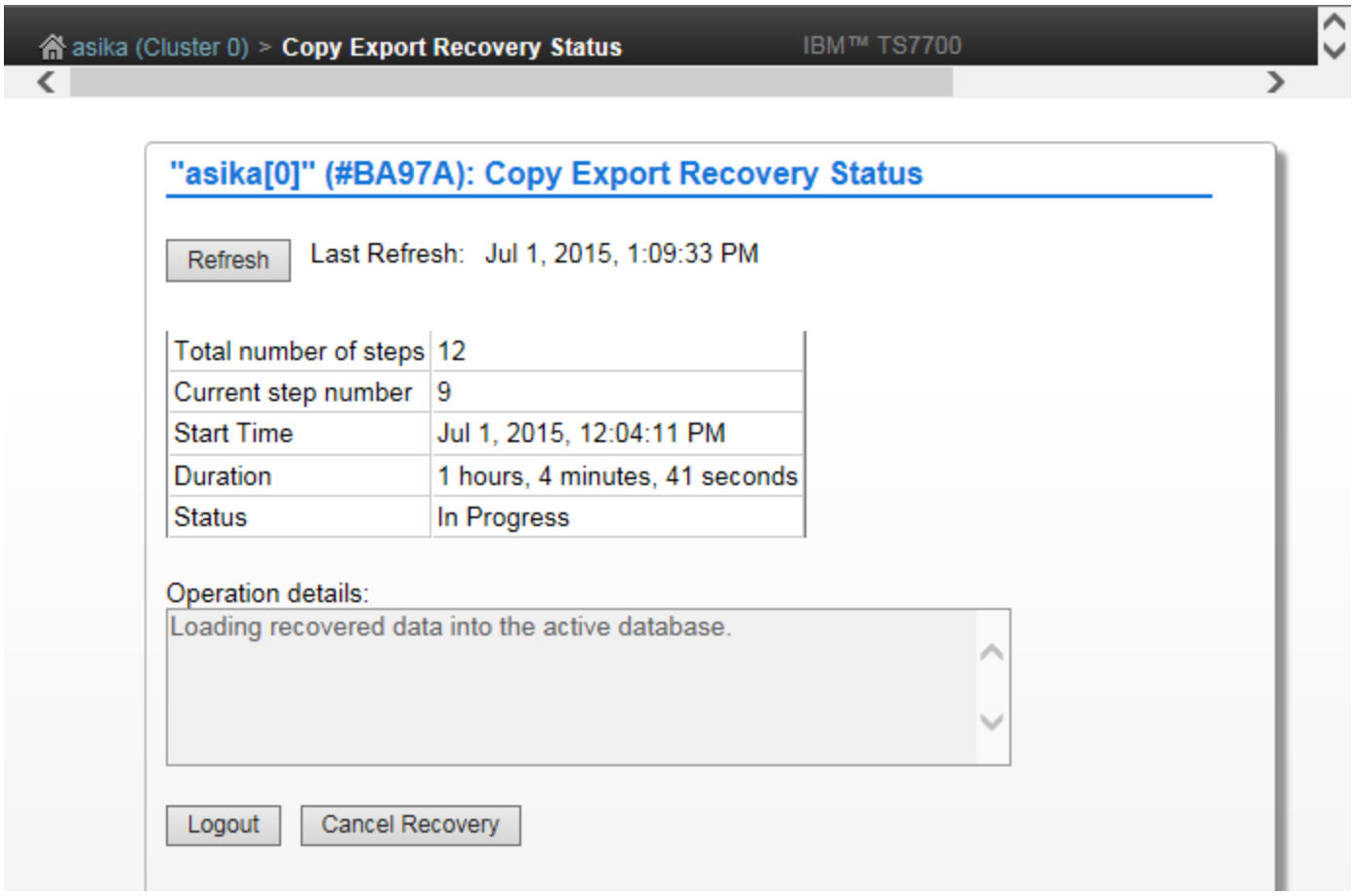
(MI page of code level 8.30.x.x or higher)



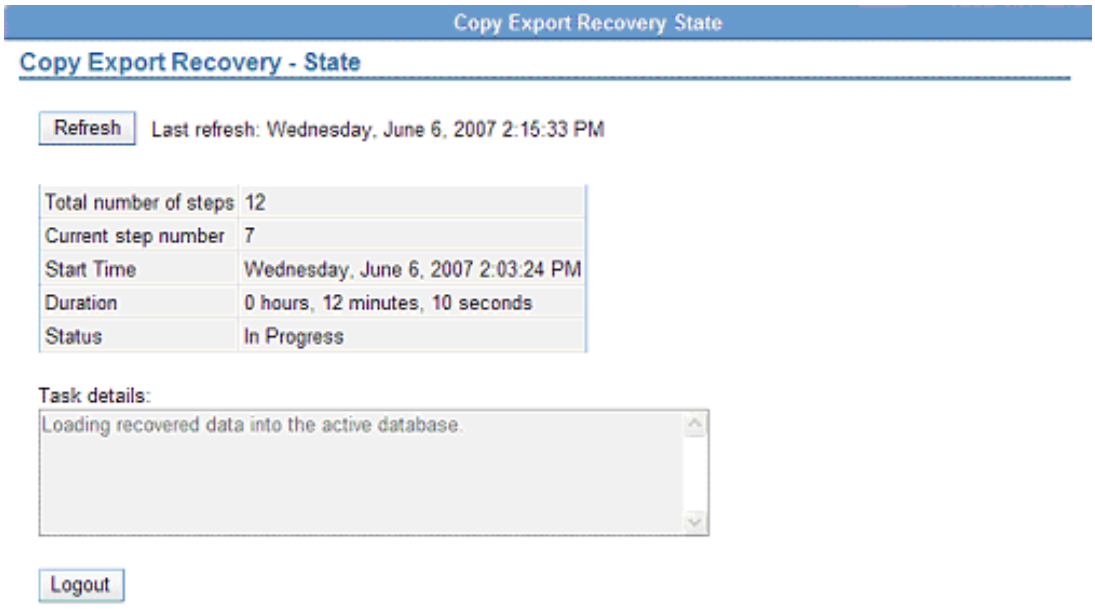
(MI page of code level from 8.5.x.x to 8.21.x.x)

11. The TS7700 will begin the recovery process. As part of this step, you will be logged off from the management interface.

12. After waiting about 1 minute, login to the management interface. Because the TS7700 is performing the recovery process, the only selection that will be available through the **Service** (at code level 8.30.x.x) or **Service & Troubleshooting** (at code level from 8.5.x.x to 8.21.x.x) menu is the **Copy Export Recovery Status** (at code level 8.30.x.x) or **Copy Export Recovery State** (at code level from 8.5.x.x to 8.21.x.x) page. Select that page to follow the progress of the recovery process. The page provides information about the process including the total number of steps required, the current step, when the operation was initiated, run duration and overall status. An example of the page is shown below:



(MI page of code level 8.30.x.x or higher)



(MI page of code level from 8.5.x.x to 8.21.x.x)

Note: To update the page, you will need to click on the **Refresh** button.

Note: You can logoff from the management interface using the **Logout** button. Logging off from the management interface does not terminate the copy export recovery process. You can log back into the management interface at a later time and if the process is still in progress, the page will provide the latest status. If the process had completed, the **Copy Export Recovery State** menu item is not available.

The following are the tasks that will be listed in the task detail window as the copy export recovery steps are being performed (The "X"s and "Y"s will be replaced by appropriate values):

- Taking the TS7700 offline.
- The requested recovery tape XXXXXX is being mounted on device YYY.
- The database backup is being retrieved from the specified recovery tape XXXXXX.
- The requested recovery tape is being demounted following retrieval of the database backup.
- The database backup retrieved from tape is being restored on the TS7700.
- The restored database is being updated for this hardware.
- The restored database volumes are being filtered to contain the set of logical volumes which were copy exported.
- Token ownership is being set to this cluster from previous cluster.
- The restored database is being reconciled with the contents of cache, XX of YY complete.
- Logical volumes are being restored on the Library Manager, XX of YY complete.
- Copy Export Recovery is complete.
- Copy Export Recovery from physical volume XXXXXX.
- Requesting the TS7700 go online.
- Preparing the logical volume information to send to the Library Manager on pre 8.5.x.x systems.
- Loading recovered data into the active database.
- In progress.

If an error occurs during the copy export recovery process, the task detail window will indicate the reason. The following table lists the possible error texts and the recommended action:

Text	**Action**
Volume XXXXXX is not known to the tape library.	1) Check that the physical volume is in the library. Check that it had been moved to 'Insert' through the Unassigned Volumes panel on the Library Manager. 2) Once you are sure that the volume is in the library, retry the copy export recovery process. **Note:** If you encountered this error because you had not placed all of the source copy exported

	physical volumes in to the library, in addition to getting them into the library, you will need to perform the Request Inventory Upload function through the library manager
The mount of volume XXXXXX on device YYY has failed.	1) Be sure the physical volume is available in the library and that the physical tape device is available and does not have an error. 2) Retry the copy export recovery process. If the device continues to fail, mark it unavailable at the Library Manager and retry the recovery again. When retried, the TS7700 will select a different available physical tape device
The database backup could not be read from the specified recovery volume XXXXXX.	1) Check that the volume specified is indeed a Copy Exported physical volume. 2) Retry the copy export recovery process. If a retry also fails, retry using a different physical volume.
The demount of the specified recovery volume XXXXXX has failed.	Recovery will continue, but a call to IBM support may be required to remove the physical volume from the physical tape device.
The database backup image has been rejected by DB2 and could not be restored.	Retry the copy export recovery process with a different physical volume. If that also fails, call IBM Support.
The database backup could not be restored.	Retry the copy export recovery process with a different physical volume. If that also fails, call IBM Support.
There has been an internal error updating the restored database.	Call IBM Support
Copy Export Recovery has completed with errors. The number of logical volumes restored to the Library Manager associated with this TS7700 [x,xxx,xxx] does not match the number of logical volumes existing in the TS7700 database [x,xxx,xxx]. This may be due to duplicate volsers in the other partition of the Library Manager.	1) The recovery TS7700 is brought online and the non-conflicting logical volumes are accessible. The logical volumes that conflicted are not accessible. If this is just a test, that may be acceptable. 2) If not, resolve the logical volume conflicts and retry to copy export recovery operation. To identify the possible logical volume conflicts, examine the logical volume volser ranges that are defined for the TS7700 and the library manager partitions for overlapping ranges.
Unable to complete sending the logical volumes to the Library Manager.	1) Ensure that Service Access is enabled on the library manager(s).

	2) If the recovery library configuration includes dual library managers, ensure that both are operational and not degraded. If that is not the case, that must be corrected and then the copy export recovery process can be retried. If the problem still persists, call IBM Support
No tape drives are available to be used to restore the exported database.	Resolve problem with the physical tape devices. At least one device must be available. Retry the copy export recovery process.
An error condition has been encountered	Call IBM Support

Once the copy export recovery process has completed successfully, the management interface will return to its full selection of tasks.

13. Now is the time to add scratch physical volumes to the library. Two scratch volumes are required for each active pool. Define the volser range(s) for the physical scratch volumes that are to be used for and after the recovery. The recovery TS7700 must know what volser range(s) it is to consider it owns. The steps used to define volser range(s) can be found in Appendix A – Volser Range Definition for systems running 8.30.x.x or higher code, Appendix B – Volser Range Definition for systems from 8.5.x.x to 8.21.x.x and Appendix C – Volser Range Definition for pre 8.5.x.x systems. Systems running 8.5.x.x with 3494 attached libraries must define the ranges on the 3494 also per Appendix C

14. If you had run copy export recovery due to a real disaster (Removing the check in the "Disaster Recovery Test Mode" checkbox) then verify that the storage management construct actions as defined will manage the logical and physical volumes in the manner needed. During copy export recovery, the storage management constructs and their actions will be restored to what was defined on the source TS7700. If you want the actions to be different, you would change them through the library manager associated with the recovery TS7700.

See the section on *Creating a New Primary/Secondary Copy after Disaster Recovery* for an example of how to re-establish a secondary copy pool so that copy export can be performed against the recovery TS7700.

If you left the "Disaster Recovery Test Mode" checkbox checked, then the TS7700 will ignore the storage management construct setting as logical volumes are accessed and closed. If you are only going to read data, there is no need to change the storage management construct actions. If you create new volumes or modify an existing volume, then the storage management construct actions will be followed and unless changed, will follow what had been defined by the source TS7700.

You can now vary the recovery TS7700's virtual drives online to its attached hosts. If you have not already done so, you would now need to restore the host environment.

Restoring the Host and Library Environment

In order to run your applications and access the data in the recovery TS7700, the source host environment must also be restored. At a minimum, you will need to perform the following general steps:

- Restore the tape management system control data set.
- Restore the DFSMS data catalogs, including the Tape Configuration Data Base (TCDB).
- Define the I/O gen using the library ID of the recovery TS7700.
- Update the library definitions in the SMS Control Data Set (SCDS) with the library IDs for the recovery TS7700 in the composite and distributed library definition panels.
- Activate the I/O gen and the SCDS.

You may also want to update the library nicknames that are defined through the management interface for the grid and cluster to match the library names defined to DFSMS. That way, the names shown on the management interface panels will match those used at the host for the composite and distributed libraries. To set up the composite name used by the host to be the grid name, select the **Grid Identification Properties** item on the **Configuration** menu. In the panel that displays, enter the composite library name used by the host into the **Grid nickname** field. You can optionally provide a description. Likewise, to set up the distributed name, select the **Cluster Identification Properties** item on the **Configuration** menu. In the panel that displays, enter the composite library name used by the host into the **Cluster nickname** field. You can optionally provide a description. The names can be updated at any time.

Note: Remember to insert logical volumes if you are going to be writing data to the recovered TS7700 once you have re-established the host environment and brought the TS7700 online.

Creating a New Primary/Secondary Copy after Disaster Recovery

If you have used the copy export recovery process because of a complete loss of the source TS7700, you will likely want to set up the recovery TS7700 so that it will be able to be used to make a new secondary copy of the data so that it can be taken to another site to protect the recovery TS7700 in the event of a future disaster.

During the recovery process, the status of the physical volumes used in the recovery process depends on whether the 'Disaster Recovery Test Mode" is selected or not. If the checkbox is checked, the physical volumes maintain a status of copy-exported. They are not changed to READ-WRITE. This is done to prevent them from being exported in a subsequent copy export operation or reclaimed and re-used.

If the checkbox is unchecked, the state of the physical volumes is changed to READ-WRITE at code level R1.4 and higher (at code level R1.3 the state is set to COPY_EXPORTED). They can be reclaimed and re-used. However, since they contain the only copy of the logical volume (the copy export physical volumes now contain the primary copy of the logical volumes at code level R1.3 and R1.4 and contain the secondary copy at code level R1.5 and R1.6), they cannot be re-exported. You will need to take additional actions to make another copy for a subsequent copy export operation.

To prepare the recovery TS7700 to perform subsequent copy export operations at code level R1.3 or R1.4 and to make the primary copy of the logical volumes ready for production at code level R1.5 or later, after the recovery operation you will need to modify the storage management construct actions on the recovery TS7700.

At pre R1.7 code, at a minimum you will need to change the definition for the management class name(s) that specified the secondary physical volume pool. For R1.7 and later the volumes will need to be mounted to re-establish the construct change.

For example, let's say that in the original source TS7700, the primary physical volume pool used was pool 1 and the storage group that specified it was SGMAIN. The secondary physical volume pool used for copy export was pool 9 and the management class name that specified that pool was MCPRIATL. In the recovery TS7700 database (that was restored) the logical volumes will have retained that information. However, the location of the primary copy of a logical volume has been changed to be that of the secondary physical volumes used in the recovery operation at code level R1.3 and R1.4. At code level R1.5 and higher, the secondary copy of a logical volume is located at the secondary physical volume pool. The physical volumes used in the recovery will have been placed in pool 9 because that is what they were assigned to in the source TS7700.

In the recovery TS7700 let's assume you leave the storage group definition the same (you can change it if you want, but it is not necessary). You will want to change the pool that is associated with the management class name MCPRIATL and you will need to update the pool properties for that pool to indicate that it is an export pool. That will now be the pool that is used for subsequent copy exports. Let's assume that you specify pool 10.

As you read or write data with the recovery TS7700, the TS7700's storage management functions will evaluate the prior and current storage management constructs definitions and perform the following actions:

- For a logical volume from the source TS7700 that is only read from

  If the logical volume was one of the ones from the source TS7700, it will be recalled into the cache as part of the mount request operation. When the volume is closed, the storage management functions will see that the primary copy of the volume was previously assigned to pool 9, but that based on the construct definitions, the primary physical volume pool is 1 and the secondary physical volume pool is

10. Because the ”Disaster Recovery Test Mode” checkbox was **not** checked, the TS7700 will follow the new construct definitions and make copies to physical volumes in pools 1 and 10. The copy in pool 9 is then no longer valid.

    Note: The evaluation to have the TS7700 follow the new construct definitions will be performed regardless of whether any data is actually read from the volume.

- For a logical volume that is newly written or modified

  If the logical volume is newly written or is an existing one that is modified, when the volume is closed the storage management functions will follow the new construct definitions and make copies to the physical volumes in pool 1 and 10.

- For a logical volume that is again read

  If the logical volume is read again and closed, the storage management functions will see that its prior pool associations are the same as the new construct definitions and no further action will be taken.

Note: Reclaiming a physical volume is not enough to have the new primary or secondary copy created as reclaim does not bring logical volumes into the cache.

The above example demonstrates that the TS7700 will not automatically create a new primary or secondary copy of the logical volumes. You will have to, at a minimum, mount and close each logical volume to have the TS7700 make the primary or secondary copy.

As the storage management function of the TS7700 makes new primary and secondary copies, the amount of active data on the physical volumes with the original status of copy-exported will decrease and they will eventually be reclaimed. Once they have been reclaimed, they must be removed from the library and then re-inserted into the library before they will be re-used as scratch volumes.

Note: At code release level R1.3, you will have to manually remove the original copy-exported physical volumes from the library to be able to re-insert them. They cannot be ejected through the library manager panels. At R1.4 or later you can use the eject function of the library manager for this.

When copy export is again performed, it must now specify pool 10 and those new secondary copies in that pool would be exported.

Checking the Status of Copy Exported Physical Volumes

It is expected that over time, a source TS7700 will have many copy exported physical volumes that have been taken to an offsite location. The logical volume data on those copy exported physical volumes will age and expire or be replaced by updated versions. So over time, the amount of active logical volume data on a copy exported volume will decrease. From time to time, you likely will want to understand the current status of the copy exported physical volumes, particularly whether or not they should be reclaimed or if one or more of them no longer contain any active data and can be returned for re-use after the next copy export operation completes. The TS7700 provides information about the copy exported physical volume in three ways.

The first and preferred method to check for empty exported media is checking the status file on the export list file. Every time a copy export operation is performed, records are written to the status file on the export list file volume that provides specific information about the amount of active data remaining on all physical volumes with a state of copy-exported.

Note: Even though a copy export operation is performed against a single secondary physical volume pool, the status file records are written for all physical volumes with a state of copy-exported, regardless of whether the pool they are in was specified for the current copy export operation.

Here is an example of records from the status file showing the information provided:

```
#VOL   POOL FM   MBYTES   %UTL MED COPY EXPORTED TIME

JA0026  24  5        0     0  5  2007-03-21-09.07.35
JA5301  22  5   493812    11  5  2007-03-24-08.05.27
JA5204  22  5   493748   146  5  2007-03-24-08.09.31
JA5328  22  5      509   782  5  2007-03-24-08.12.08
JA5223  22  5   492283   899  5  2007-03-31-09.57.22
JA5297  22  5   493809   929  5  2007-03-31-09.49.37
JA5376  22  5   317385   959  5  2007-03-31-09.55.51
JA5257  22  5   493826   973  5  2007-03-31-09.51.44
JA5365  22  5    23651  1000  5  2007-04-04-06.28.24
SA5366  22  5    13351  1000  5  2007-04-04-06.33.24
JA0101  24  5      234  1000  7  2007-04-03-18.42.12
JA0145  24  5   493078  1000  7  2007-04-03-18.47.12
```

The columns of interest here are the fourth column, which indicates the number of MBytes of data written to the volume when it was exported, and the fifth column, which indicates the percentage of that data that is still active, in tenths of a percent, rounded down (so a volume with less than 0.1% active data will be reported as 0). Once there is no longer any active data on the volume, the value in the fourth column will be set to 0.

In this example if the current copy export operation was for pool 24, you can see that volume JA0026 no longer has any active data on it. It should be brought back for re-use when the next copy export operation for pool 24 completes and those volumes are taken off-site. Volumes JA5301 and JA5204 have only 1.1 and 14.6 % active data on them respectively and should be considered candidates for reclaim. All of the other volumes contain all or mostly active data.

One important thing to note is that for some of the volumes in this example, the amount of data on them when the volume was exported is less than the capacity of the volume. This is because copy export does not just export the volumes in the pool that are marked as full. If any volume in the secondary physical volume pool has any active data on it, regardless of if it is less than the capacity of the media, that volume is exported. Looking at this example, you could decide that volume JA5328 should also be considered a candidate for reclaim, because although it contains 78.2% active data, that is 78.2% of the 509 MBytes that

were written to the volume when it was exported, so there is actually less active data on it than there is on volume JA5204 (JA5204 has over 72,000 active MBytes versus JA5328 which has only 398 active MBytes).

The second method is by using the host console request command, Library Request with keysords PVOL,XXXXXX; where XXXXXX is the physical volume volser, to ask for the information about a specific physical volume that you know has been copy exported. The information returned includes the number of Mbytes of data written to the volume when it was exported and the current percentage of that data that is active. As with the information provided in the status file on the export list file volume, you can use this information to decide whether a volume should be considered a candidate for reclaim or is empty of any active data. However, the library request showing “EMPTY” indicates the exported physical volume is empty in current database. It can be inconsistent with the database backup gotten at previous Copy Export operation. Hence, the information gotten by this library request should not be used for decision of returning empty exported physical volumes to the library fore re-use after the next export operation completes and the physical volumes are taken off-site. Here is an example of the data returned for a physical volume:

```
PHYSICAL VOLUME INFORMATION V1
 PHYSICAL VOLUME:  AB0203
 MEDIA TYPE:       JA
 DRIVE MODE:       E05
 FORMAT:           TS7700
 VOLUME STATE:     COPY-EXPORTED
 CAPACITY STATE:   FULL
 CURRENT POOL:     1
 MBYTES WRITTEN:   497413
 % ACTIVE DATA:    85.2
 LAST INSERTED:    2006-12-23 19:34:27
 WHEN EXPORTED:    2007-4-12 08:51:31
 MOUNTS:           34
 LOGICAL VOLUMES:  254
 ENCRYPTED:        N
```

The third method is to use the BVIR-Physical Volume Status Pool xx function, where xx is the pool you want the information on. For each physical volume in the specified pool, a lot of information is returned. The particular fields of interest for copy export are whether the volume has a state of copy-exported, the amount of data in MBytes that was written to the volume when it was exported and the current percentage of that data that is active. BVIR showing “EMPTY” about the exported physical volume indicates it is empty in current database. It can be inconsistent with the database backup gotten at previous Copy Export operation. Hence, the information gotten by this BVIR should not be used for decition of returning empty exported physical volumes to the library for re-use. Refer to the white paper - *IBM Virtualization Engine TS7700 Series Bulk Volume Information Retrieval User’s Guide* for specifics about the physical volume status pool request.

After copy export recovery has been performed, it is important to remember that the physical volumes used in the recovery will still have a status of copy-exported and will be included in the status file on the export list file volume even though they are resident in the source TS7700. You can differentiate the new copy-exported volume from the ones used in a recovery by looking at the data-time value for when they were last exported. The new ones would have a data-time value after the copy export recovery was performed.

Reclamation of Copy Exported Physical Volumes

Even though a copy exported physical volume has been ejected from a source TS7700 and taken to another location, the source TS7700 continues to perform space management for them. Their active data content is tracked just like any other physical volume in the TS7700. As the primary logical volumes in the source TS7700 are modified, returned to scratch and deleted or ejected from the library, and thus resulting in a reduction in the amount of active data on the physical volumes in the primary physical volume pool, the same is done for the secondary copies that are on copy exported physical volumes assigned to a secondary physical volume pool. Offsite reclamation of the secondary copies only adheres to the reclamation threshold requirements for establishing which volumes are eligible for reclamation. Other reclamation settings (Days without Access, Age of Last Data Written, Days without Data Inactivation and Maximum Active Data) do not apply to offsite reclamation. In addition to becoming eligible for reclamation because a copy exported volume meets the reclaim threshold criteria, you can make a copy exported volume eligible for priority reclaim by using the host console request function, Library Request. Using that request, you would specify the keywords COPYEXP,yyyyyy,RECLAIM; where yyyyyy is the volser of the copy exported volume you want to reclaim.

Every 10 minutes, the TS7700 checks to see if there are any copy exported volumes that have been made eligible for reclaim. If it finds one, it will begin to reclaim that volume. Reclaim through the Library Request function is issued at a higher priority than normal reclaim processing and ignores the inhibit reclaim schedule. Remember that normal reclaim processing does not check the ratio between active data size and media capacity but check if the ratio between active data size and total bytes written to the physical volume with reclaim threshold percent.

Note: If you wish to only have a copy exported physical volume become eligible for reclaim through the Library Request function, you would need to make sure the reclaim threshold definitions for the pool associated with the volumes are all set to 0, including the reclaim percentage.

Physical volumes exported with copy export that become eligible for reclaim are not brought back to the source TS7700 to be reclaimed. Instead, the source TS7700 performs the following steps (This is called Offsite Reclaim):

- Confirm that Copy Export is not running on the source TS7700 because reclamation of copy exported physical volumes does not start while Copy Export is running.
- The source TS7700 determines which logical volumes on the exported physical volume are still valid.
- For each of the valid logical volumes, it uses the primary copy of the volume as the source for the reclaim, recalling it into cache and then migrating it to a physical volume associated with the secondary volume pool the exported stacked volume is also associated with. As with any reclaim, the logical volume's record in the TS7700 database is updated to indicate the new location of the secondary copy of the volume. This also results in the amount of valid data on the exported physical volume being reclaimed to decrease, eventually reaching zero when all of the valid logical volumes have been processed.

- With code level 8.41.2xx.x or higher, the Offsite Reclaim function will not process the reclamation of a copy exported tape if one or more logical volume mapped to the copy exported tape exists on a damaged physical volume since the primary copy of the logical volume can't be recalled. This change in behavior has been put in place to avoid Offsite Reclaim repeatedly processing the same copy exported tape when the logical volume recall will never succeed due to the damaged physical volume. Code levels 8.41.1xx.x and lower do not have the fix and can result in Offsite Reclaim getting stuck in a loop attempting to reclaim the same copy exported tape over and over again. If this error condition occurs, in order for Offsite Reclaim to proceed, the damaged physical volume must first be recovered. The damaged physical volume is normally handled automatically by the TS7700 where it is marked for Read-Only Recovery. The Read-Only Recovery process will slowly attempt to recall each logical volume off the damaged physical volume, and then queuing pre-migration requests for the logical volume to two new physical volumes, creating new primary and secondary logical volume copies. If the damaged physical volume can't be mounted for recalls, it is necessary to ensure that there is another means to obtain a copy of each logical volume mapped to that damaged physical volume. This might require inserting copy exported tapes that contain the secondary logical volume copies. If there is another copy of the logical volume in another cluster in the Grid, the Read-Only Recovery process will automatically pull in a logical volume copy.
- The maximum number of drives used for migrating logical volumes to create secondary copy at Offsite Reclaim is limited by the Maximum Devices of the copy export pool defined by the MI Pool Properties.
- Limit the number of exported physical volumes Offsite Reclaim processes at a time is 10 or fewer at the code level earlier than 8.30.1.15. At the code level 8.30.1.22 or later, Offsite Reclaim processes exported physical volumes one by one in the ascending order of active data size recorded on them.
- The maximum number of reclaim set by the host library request (LIBRARY REQ,distibname,SETTING,RECLAIM,RCLMMAX,x) is not applied the number of drives used by Offsite Reclaim.

Once an hour, the TS7700 determines if any copy exported volumes that had been made eligible for reclaim through the Library Request function have completed their reclaim processing. If reclaim processing for the exported physical volume is completed successfully, an informational message is sent to all hosts attached to the TS7700 or Grid indicating that an exported physical volume has been reclaimed and is empty. On z/OS hosts, the message results in a console message being written in the following format:

CBR3750I Message from library *library-name*: R0000 RECLAIM SUCCESSFUL FOR EXPORTED STACKED VOLUME YYYYYY

Note: This message is only generated for Library Request initiated reclaims, reclaim of copy exported volumes that were made eligible through normal pool policy do not result in this message

The next time a copy export operation is performed for the secondary physical volume pool, the newly written physical volumes containing the reclaimed active logical volumes will be included in the operation. The database backup on those newly exported volumes will have the latest logical to physical volume mapping information and would show that the reclaimed copy exported volume no longer have any logical volumes on them. The now empty copy exported volumes can be returned to the source TS7700 and re-inserted for re-use as scratch volumes.

Normally, you would return the empty copy exported volumes to the library I/O station associated with their source TS7700 and re-insert them. They would then be reused by that TS7700. If you want to move them to another TS7700, keep two things in mind. First, you would need to ensure that the volser ranges you had defined for that TS7700 matches the volsers of the physical volume(s) you want to move. And second, you will need to tell that source TS7700 to stop managing those volumes. To do that, you would use the host console request function, Library Request, specifying the keywords; COPYEXP,yyyyyy,DELETE, where yyyyyy is the volser of the copy exported volume.

Note: Prior to Release 1.7, a physical volume that is marked export-hold and left in the source TS7700 library will remain in export-hold even if it no longer has any active data on it. In order to have this volume be returned to scratch for eventual re-use, it will need to be ejected and then re-inserted into I/O station. Starting with Release 1.7, when an export-hold volume no longer has active data on it, it will automatically be set to scratch for eventual re-use when next Copy Export starts.

Grid Considerations for Copy Export

Copy export is supported in a Grid configuration, but there are several considerations regarding that support. Support is provided starting with the 8.4.x.x code level.

The first has to do with how copy export is performed. In a Grid configuration, a copy export operation is performed against an individual TS7700, not across all TS7700s. In setting up to use copy export in a Grid you will need to plan for the following:

- Decide on which TS7700(s) in a Grid configuration is going to be used to export a specific set of data. Although you can set up more than one TS7700 to export data, only the data from a single source TS7700 can be used in the recovery process. You cannot merge copy exported volumes from more than one source TS7700 in the recovery TS7700.
- For each specific set of data to export, define a management class name. On the TS7700 that will be used to export that data, define a secondary physical volume pool for that management class name and also make sure that you indicate that it is an export pool. Even though you will need to define the management class name on all TS7700s in the Grid configuration, only specify the secondary physical volume pool on the TS7700 that is to perform the export operation. Specifying it on the other TS7700s in the Grid configuration will not interfere with the copy export operation, but it will be a waste of physical volumes. The exception to this would be if you want one of the TS7700s in the Grid configuration to have a second physical copy of the data in the event that the primary copies on other TS7700s are not accessible.
- As you are defining the management class name for the data, also make sure that the TS7700 to perform the export operation will have a copy policy specifying it is to have a copy.
- When the copy export operation is executed, the export list file volume must only be valid on the TS7700 performing the operation. You will need to define a unique management class name to be used for the export list file volume. For that management class name, you will need to define its copy policy such that a copy is only on the TS7700 that is to perform the export operation. If the volser specified for the export list file volume when the export operation is initiated is resident on more than one TS7700, the copy export operation will fail.
- On the TS7700 on which a copy export operation is initiated, do not set items of Copy Policy Override checked through the management interface panel. Activating Copy Policy Override, allows a copy of export list volume created on the TS7700 regardless of the management class setting and causes copy export failure. For instance, assuming three clusters c0, c1, c2 exists in a grid configuration. A copy export with the export list volume EXP000 is initiated from a host connected to the c0, and the copy export runs on the c2. The copy mode of EXP000 must be [N,N,D] or [N,N,R] indicating that the only copy of EXP000 exists on c2. If Copy Policy Override is actived on the c0 and the copy export is initiated from the host attached to c0, a copy of EXP000 is created both on the c0 and c1. Grid detects that a copy of EXP000 exists on 2 clusters (co and c2) and does not start the copy export. Copy export fails

For example, assume that the TS7700 that is to perform the copy export operation is cluster 1. The pool on that cluster to export is pool 8. You would need to set up a management class for the data that is to be exported such that it will have a copy on cluster 1 and a secondary copy in pool 8. To ensure the data is on that cluster and is consistent with the close of the logical volume, you would want to have a copy policy of Rewind/Unload (RUN). Define a management class, for example, of MCCEDATA, on cluster 1 as follows:

Management Class: MCCEDATA
- Secondary Pool: 8
- Cluster 0 Copy Policy: RUN
- Cluster 1 Copy Policy: RUN

You would also define this same management class on cluster 0 without specifying a secondary pool.

To ensure that the export list file volume gets written to cluster 1 and only exists there, you would define a management class, for example, of MCELFVOL, on cluster 1 as follows:

Management Class: MCELFVOL
- Cluster 0 Copy Policy: No Copy
- Cluster 1 Copy Policy: RUN

You would also define this management class on cluster 0 as follows:

Management Class: MCELFVOL
- Cluster 0 Copy Policy: No Copy
- Cluster 1 Copy Policy: RUN

A copy export operation can be initiated through any virtual tape drive in the TS7700 Grid configuration; it does not have to be initiated on a virtual drive address in the TS7700 that is to perform the copy export operation. The operation will be internally routed to the TS7700 that has the valid copy of the specified export list file volume. Operational and completion status will be broadcast to all hosts attached to all of the TS7700s in the Grid configuration.

Only the logical volumes resident on the TS7700 performing the operation, at the time it is initiated, are exported. If a logical volume has not been copied yet or completed its copy operation when the export operation is initiated, it is not considered for export during the operation. It is assumed that copy export is performed on a regular basis and logical volumes, whose copies were not complete when a copy export was initiated, will be exported the next time copy export is initiated. You can check the copy status of the logical volumes on the TS7700 that is to perform the copy export operation prior to initiating the operation by using the Volume Status function of the BVIR facility. You can then be sure that all critical volumes will be exported during the operation.

The next has to do with how copy export recovery is performed. Copy export recovery is always to a standalone TS7700. As part of the recovery process, the recovery TS7700 will process all grid related information in the database converting it to look like a single TS7700. This means that the recovery TS7700 will have volume ownership of all volumes. It is possible that one or more logical volumes will become inaccessible because they were modified on a TS7700 other than the one that performed the copy export operation and the copy did not complete prior to the start of the operation.

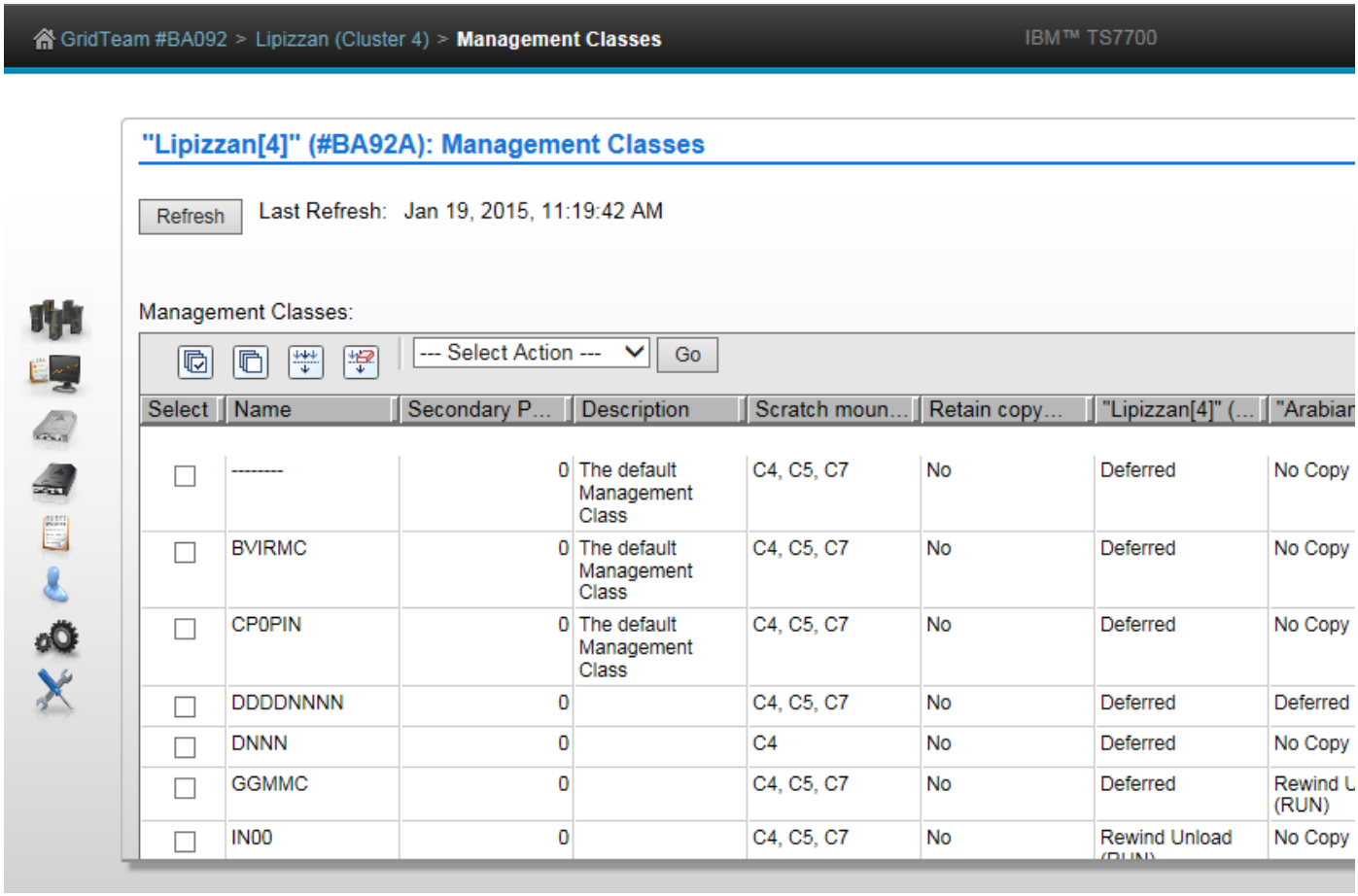
The last has to do with returning copy exported physical volumes when they are empty. Remember that each copy exported physical volume remains under the management of the TS7700 that it was exported from. Normally, you would return the empty physical volumes to the library I/O station associated with the source TS7700 and re-insert them. They would then be reused by that TS7700. If you want to move them to another TS7700 whether in the same Grid configuration or another, keep two things in mind. First, you would need to ensure that the volser ranges you had defined for that TS7700 matches the volsers of the physical volume(s) you want to move. And second, you will need to use the host console request function,

Library Request (Library Request,libname,copyexp,volser,delete), to have the original TS7700 stop managing them.

Appendix A – Processes for 8.30.x.x and Higher Systems

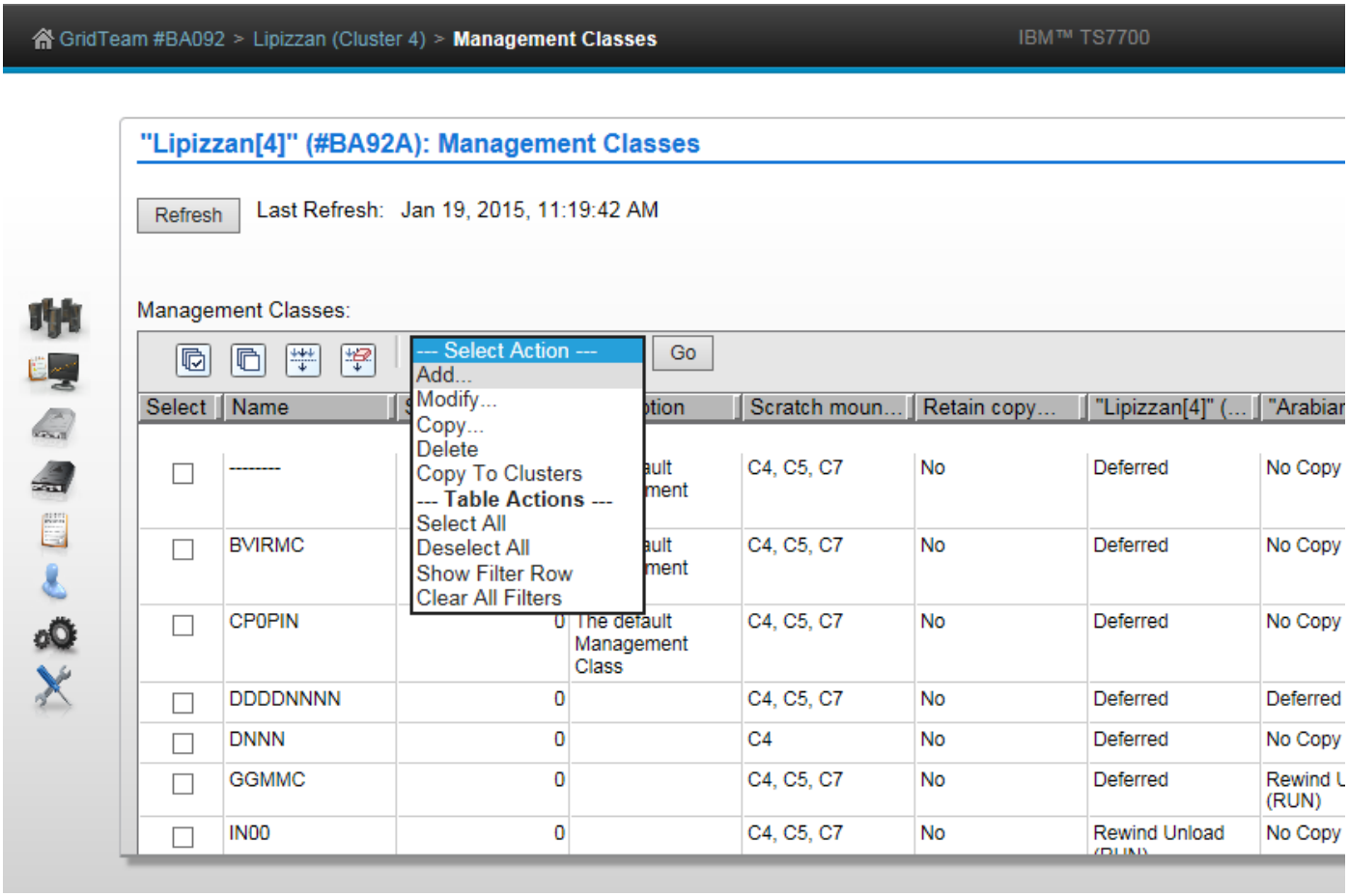
Management Class Definition

Begin by selecting the **Constructs** icon**.** Then select **Management Classes**. The figure below shows the Management Classes panel.

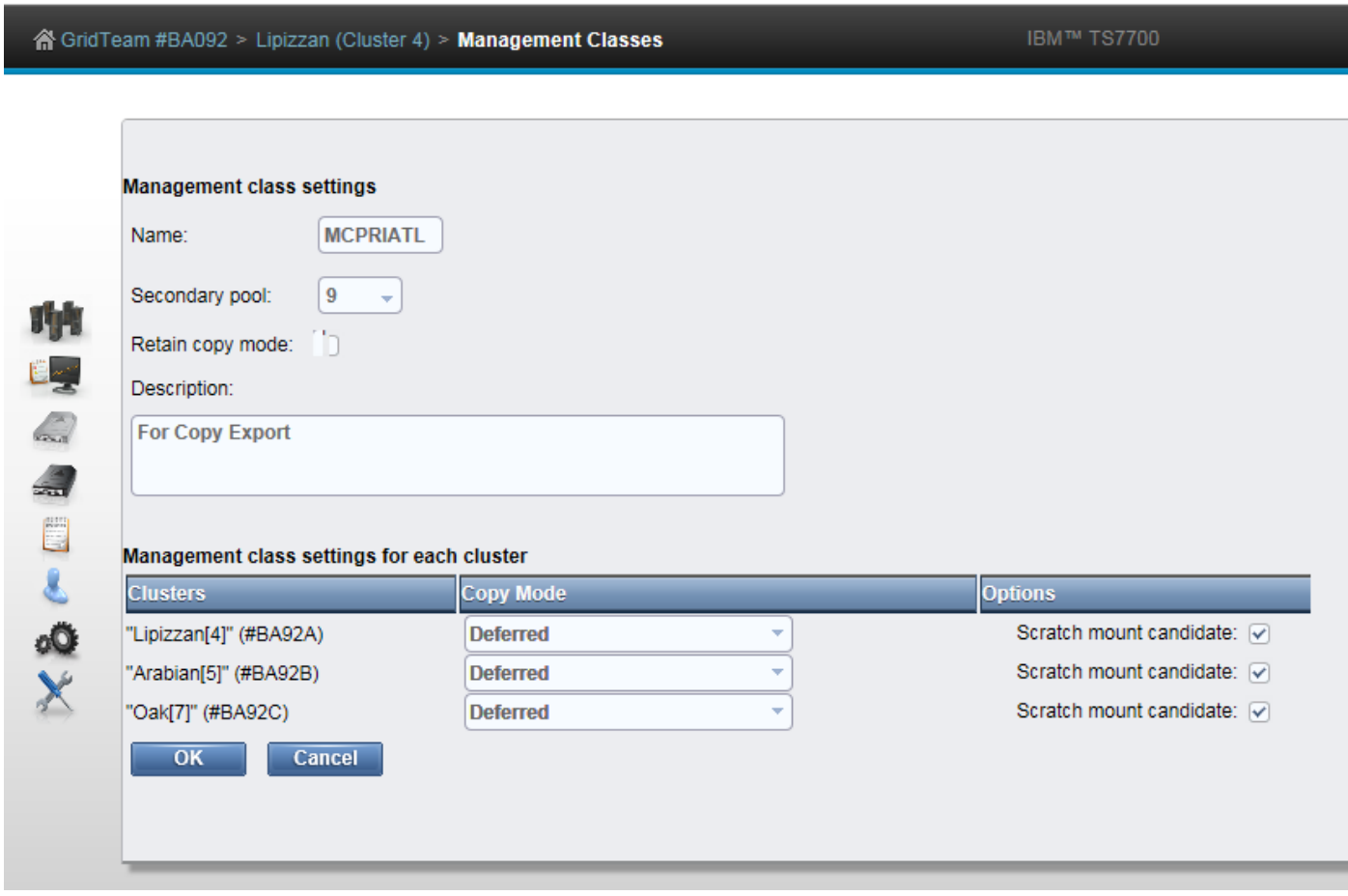


Ÿ To add a management class:

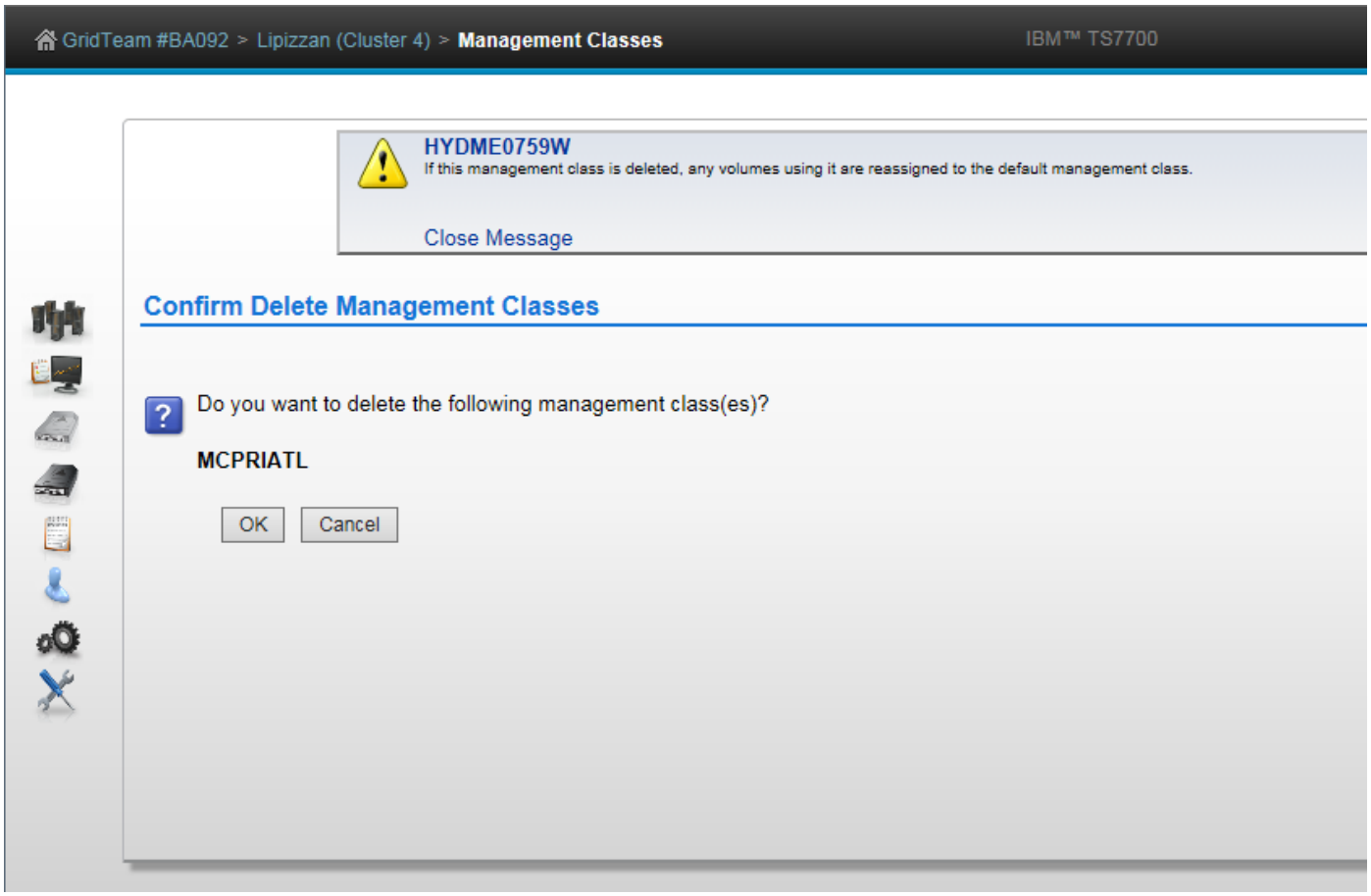
1. Select **Add** from the Select Action options then press **Go**



2. Enter a one to eight-character alphanumeric name in the **Name** field. The name must be unique within the management class construct names defined for the library. In this example, a definition for management class MCPRIATL is being added.
3. Select a **Secondary Pool**. It is recommended that a single secondary pool be associated with a single management class name for copy export use. In this example, pool 9 is being specified,
4. Enter a short description in the **Description** field.
5. If this is a grid configuration, enter **Copy Mode** for the TS7700s. Refer to the *IBM® Virtualization Engine TS7700 Series Best Practices - Copy Consistency Points* whitepaper (WP101230) on Techdocs for a description of Copy Mode.
6. Select the **OK** button to save the management class.

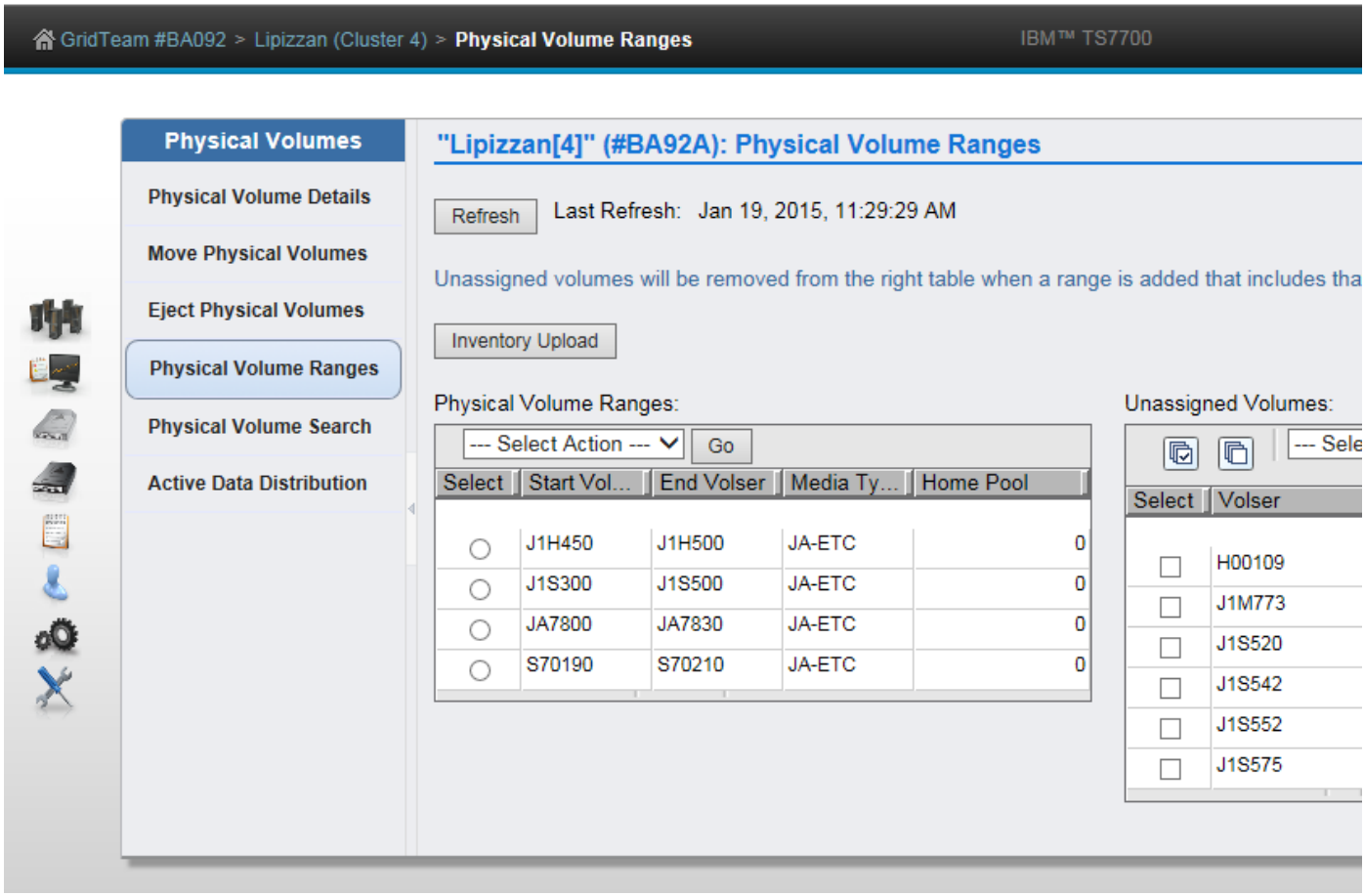


- To modify a management class, select from the list of current management classes listed. Click on the management class you want to modify. Select **Modify** from the Select Action options. Select **Go** to continue. Make modifications to the secondary pool, other attributes and/or description. Select the OK button to save the management class changes.
- To delete a management class, select from the list of current management classes listed. Click on the management class you want to delete. Select **Delete** from the Select Action options. Select **Go** to continue. Select **OK** to confirm deletion.



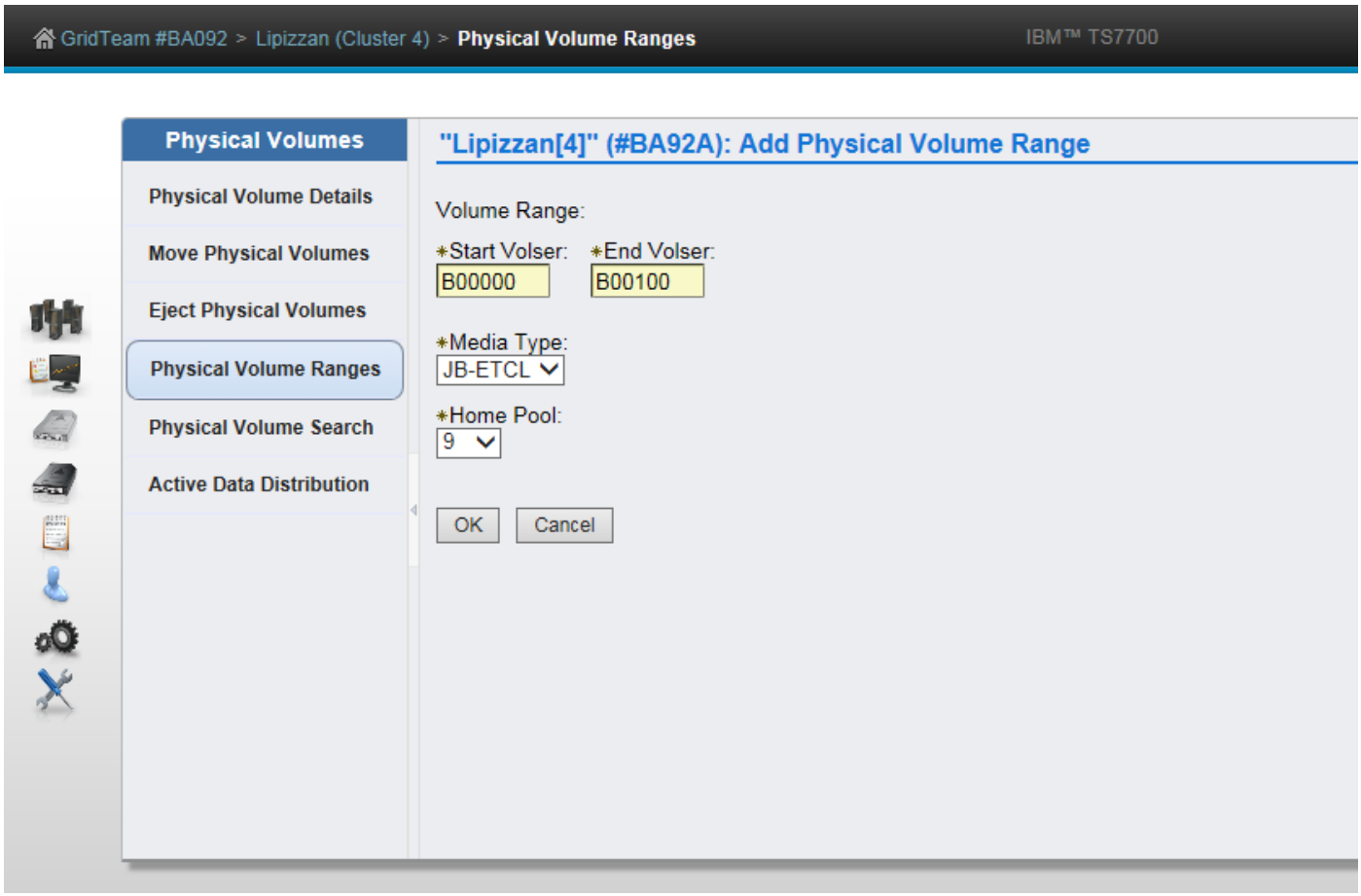
Volser Range Definition

Begin by selecting the **Physical Volumes** in **Physical** icon**.** Then select **Physical Volume Ranges** tab. The figure below shows the Physical Volume Ranges panel.



Ÿ To add a range on the TS7700:

1. Select **Add** from the Select Action options then press **Go**



2. Enter volsers in the **Start Volser** and End Volser fields. In this example, a range from B00000 to B00100 is being defined..
3. Select a Media Type compatible with 3592. For this example, the JB media type is being selected.
4. Select the **Home Pool**. For this example, pool 9 is being specified and I want the range of volsers to go to that pool when they are added to the library.
5. Select the **OK** button.

Ÿ To expand a range, click on the range presented in the list, select **Modify** from the Select Action options then press **Go**. Make changes to the Start and/or End Volser fields, select the **OK** button.

Ÿ To delete a range, click the range presented in the list, select **Delete** from the Select Action options then press **Go**. On the confirmation screen select **YES**.

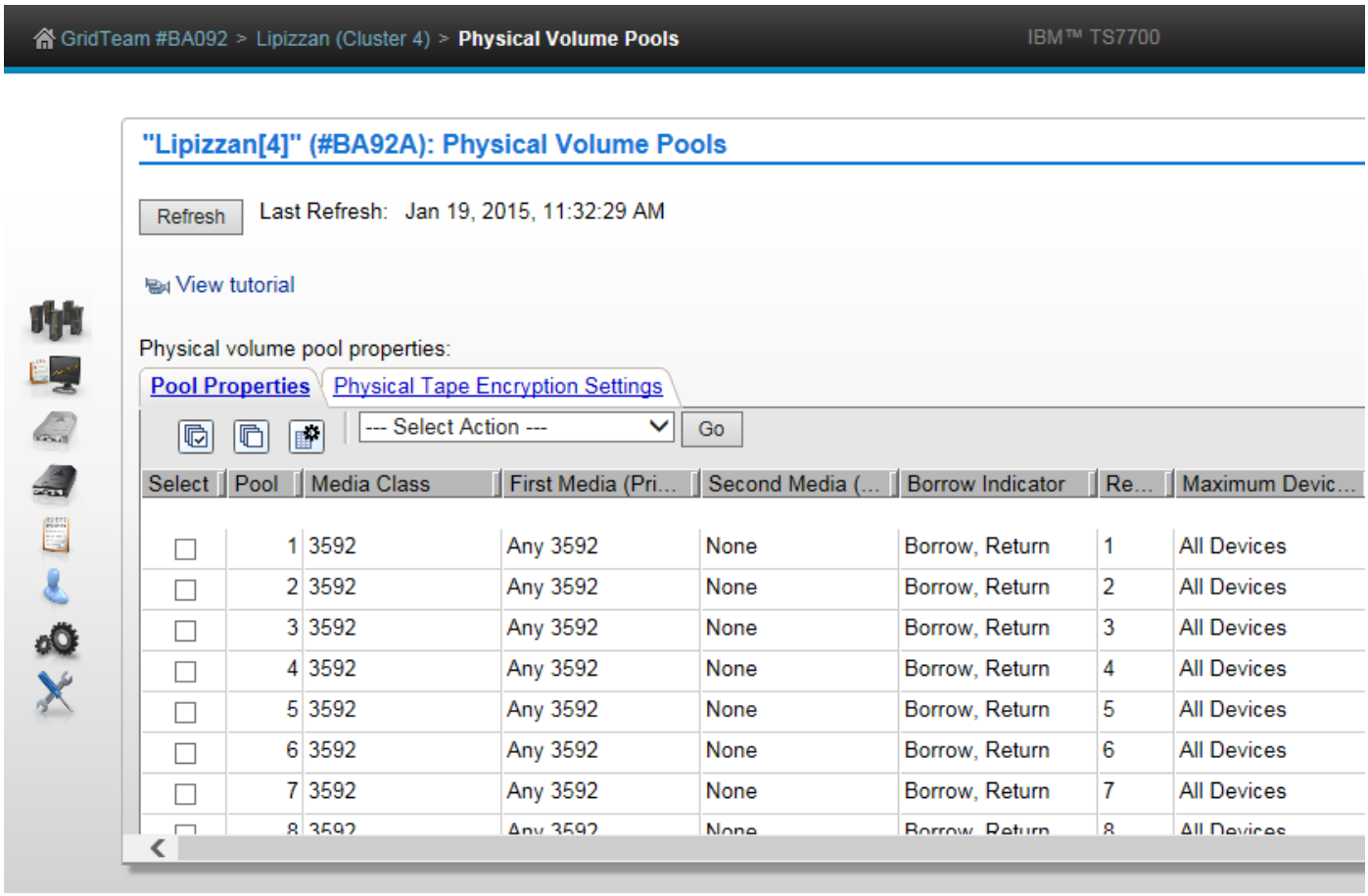
Ÿ If the TS7700 is attached to a 3584 library then set up the Cartridge Assignment Policies per the instructions in Appendix D for the same ranges

Ÿ If the TS7700 is attached to a 3494 library then setup the Volser Ranges on the 3494 using the instructions in Appendix C Volser Range Definition

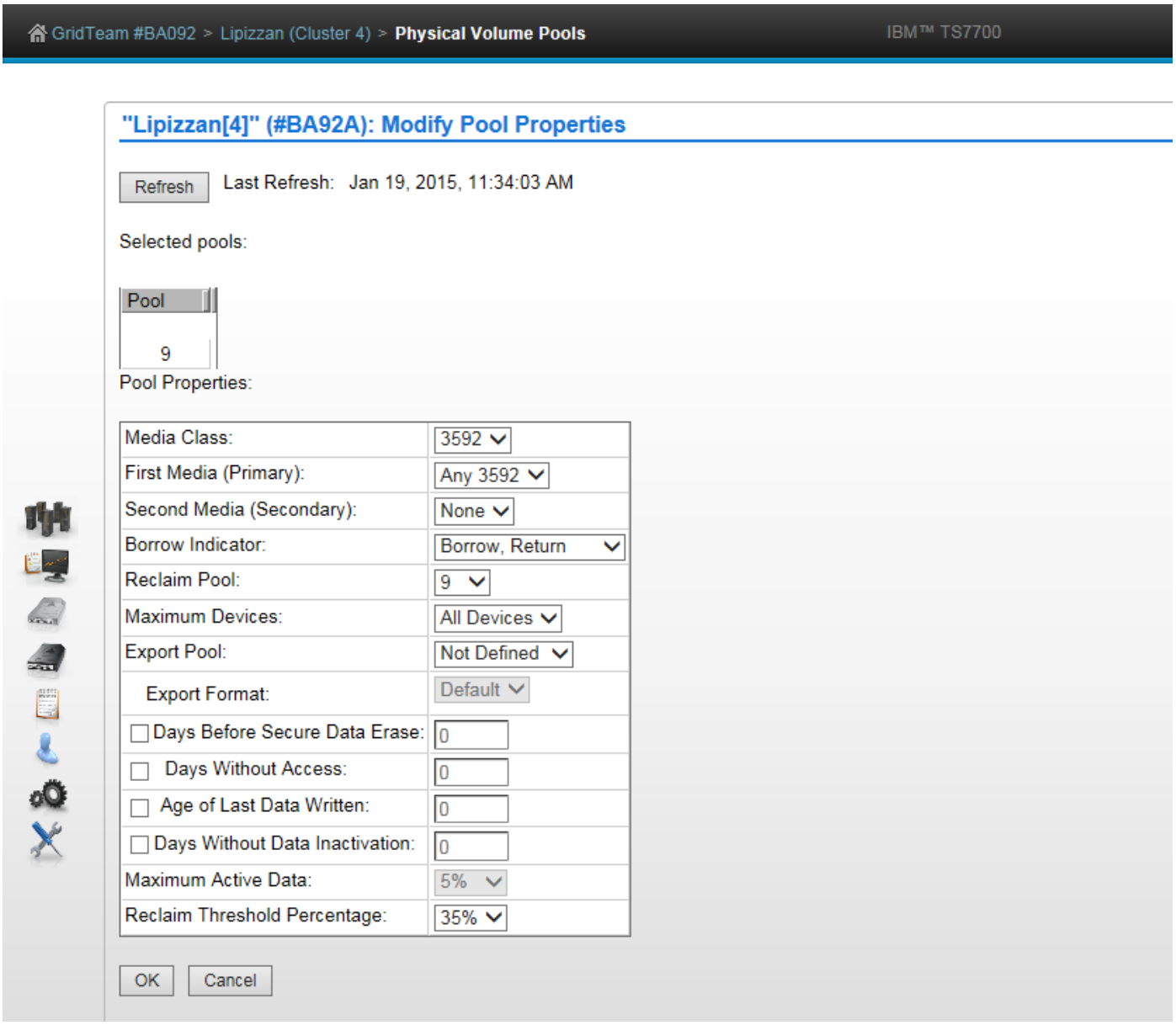
Manage Physical Volume Pool Properties

Begin by selecting the **Physical Volumes** in **Physical** icon**.** The figure below shows the Physical Volume Pools panel.

1. Check the box beside the pool to be modified and select **Properties** from the Select Action options then press **Go**



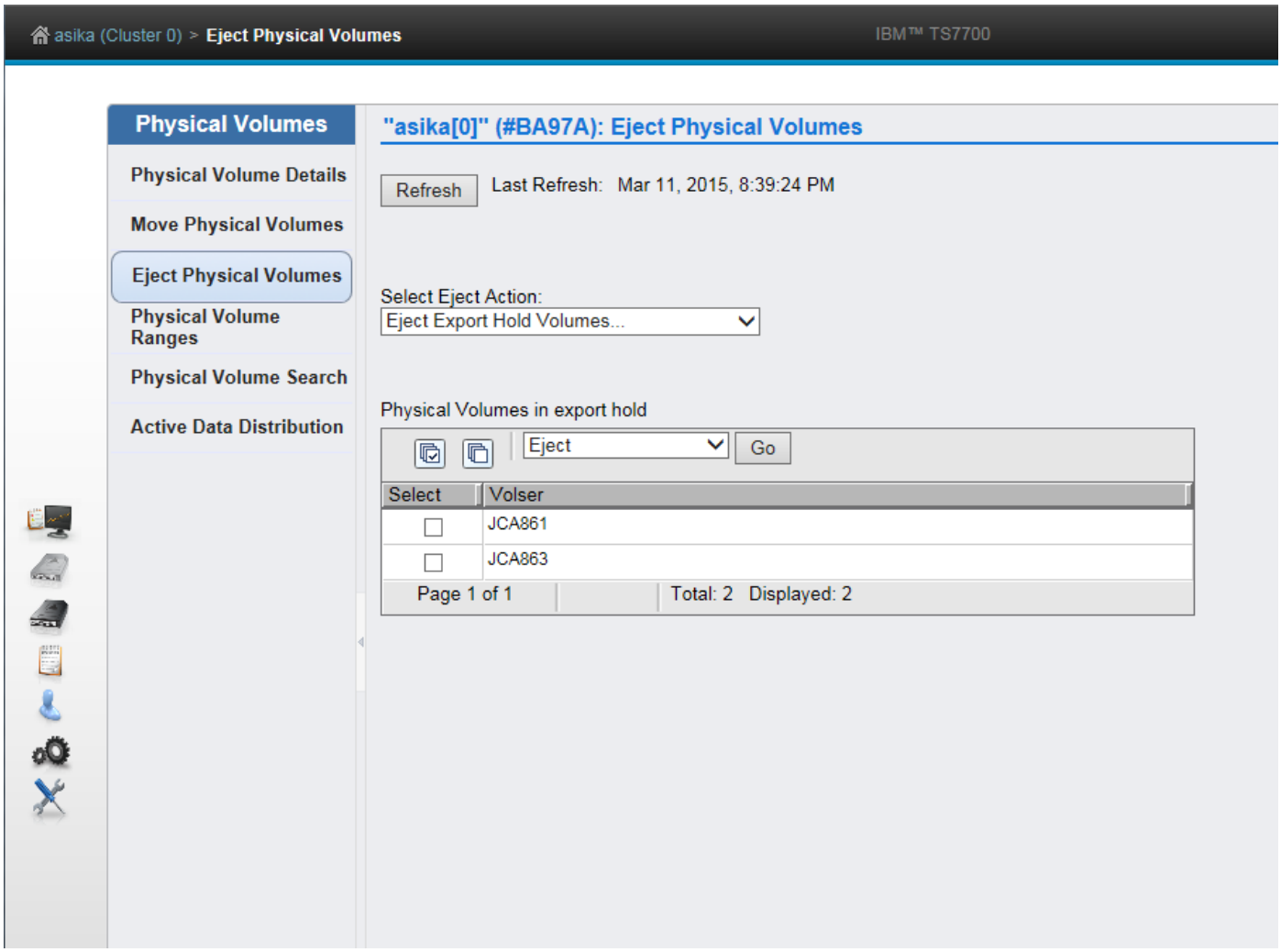
- To modify the pool properties:
  1. On the Export Pool field select Copy Export from the pull down
     Note: You will not be able to change this pool setting if the pool has already been associated with a storage group name. Associating a pool with a storage group name makes that pool a primary storage pool and a primary storage pool cannot be use for a copy export pool.
  2. Select a **Borrow Indicator.** The setting defines if the pool borrows physical volumes from the common scratch pool (Pool 00) and whether they are returned to the common scratch pool when reclaimed. For this example, the pool will borrow and return all volumes assigned to it.
  3. Select the **1st & 2nd Media** types to be borrowed/returned from/to the common scratch pool (if borrow was indicated).
  4. Select the **Reclaim Pool.** The default is to the same pool. If the reclaim pool is modified, copy export disaster recovery capabilities can be compromised. If there is a need to modify the reclaim pool designated for the copy export pool, the reclaim pool **CANNOT** be set to the same value as the primary pool or the reclaim pool designated for the primary pool. If the reclaim pool for the copy export pool is the same as either of the other two pools mentioned, then primary and backup copies of a logical volume may exist on the same physical media. If the reclaim pool for the copy export pool is modified, it is the customer's responsibility to copy export volumes from the reclaim pool.
  5. Select the **Maximum Devices.** Leave at the default of All Devices unless you want to limit the number of drives that will be used for copying data from the cache to physical volumes. This setting specifies how many physical devices the TS7700 may use concurrently when copying data from cache to the pool. If you set the default or a large value here, you may have many copy exported physical volumes with small amount of data on each. A value of 1 minimizes the number of physical volumes used for copy export, but the time to copy data from cache will take longer. The best value depends on the amount of data exported. For example, if you estimate you would normally export about 8TB data and use JC media, the data could fit on as few as 2 physical volumes, so you may want to set this field to 2. It is possible that an additional volume may be used depending on drive and physical volume availability when data is copied from the cache to physical tapes during a copy export operation.
  6. Set up the reclamation policies by entering values in the **Days without Access, Age of Last Data Written, Days Without Data Inactivation** and **Maximum Active Data** fields. A value of 1 to 365 days may be specified. If you do not want a policy to be included, set the field to 0. In this example, all reclaim values have been set to 0. Maximum Active Data defaults to 5% (Note: These parameters are not applied for Offsite Reclaim)
  7. Let **Reclaim Threshold Percentage** default to 10%
  8. Select the **OK** button.



Manage Export Hold Volumes

Begin by selecting the **Physical Volumes** in **Physical** icon**.** Then select the **Eject Physical Volumes** tab. The figure below shows the Eject Physical Volumes panel:

1. From the Select Action options choose the Eject Export Hold option
2. Put a check next to the volumes you want to eject and choose **Eject** from the action pulldown then choose **Go**



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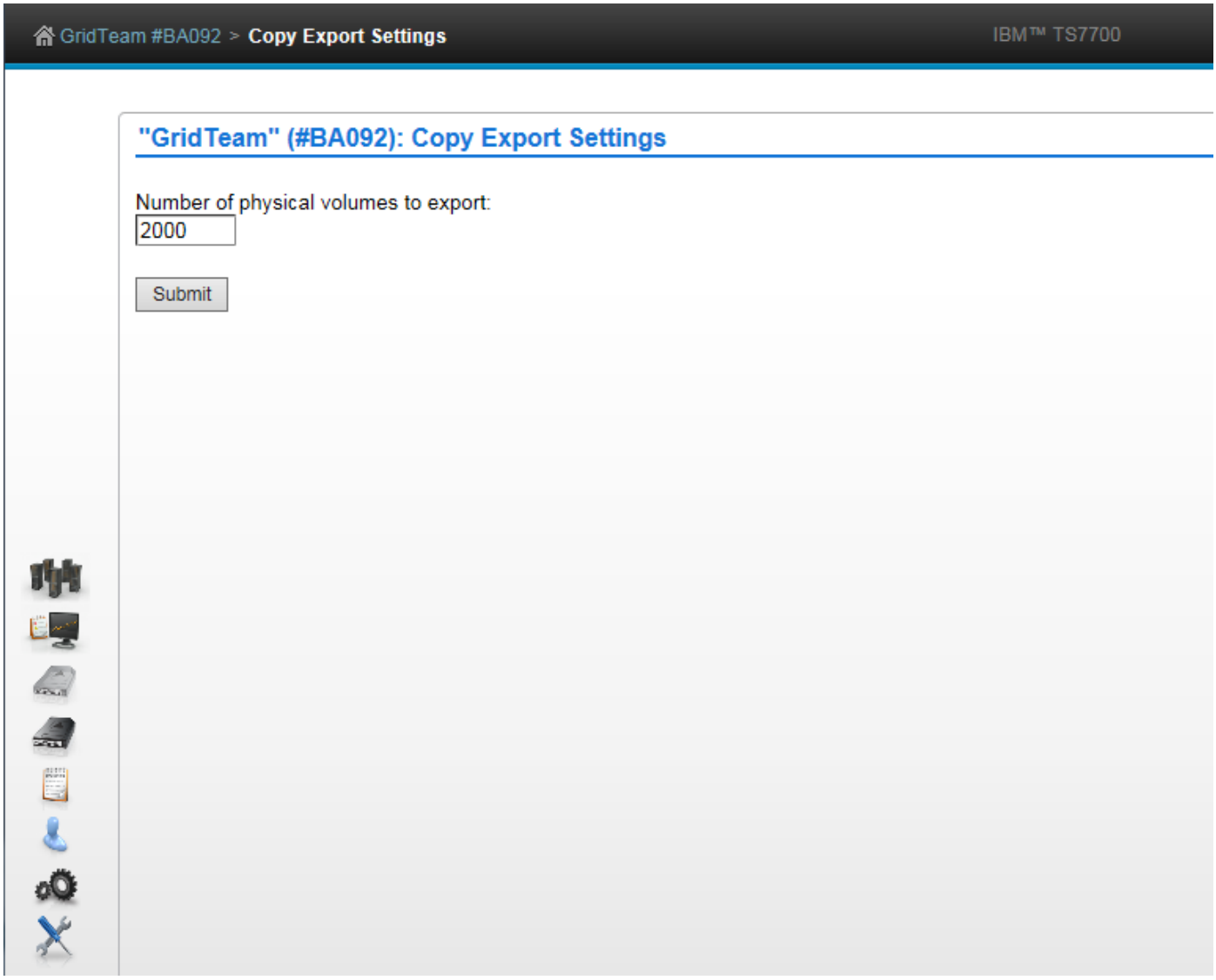
Copy Export Settings

Begin by selecting the **Copy Export Settings** in **Settings** icon**.** The figure below shows the Copy Export Settings panel:

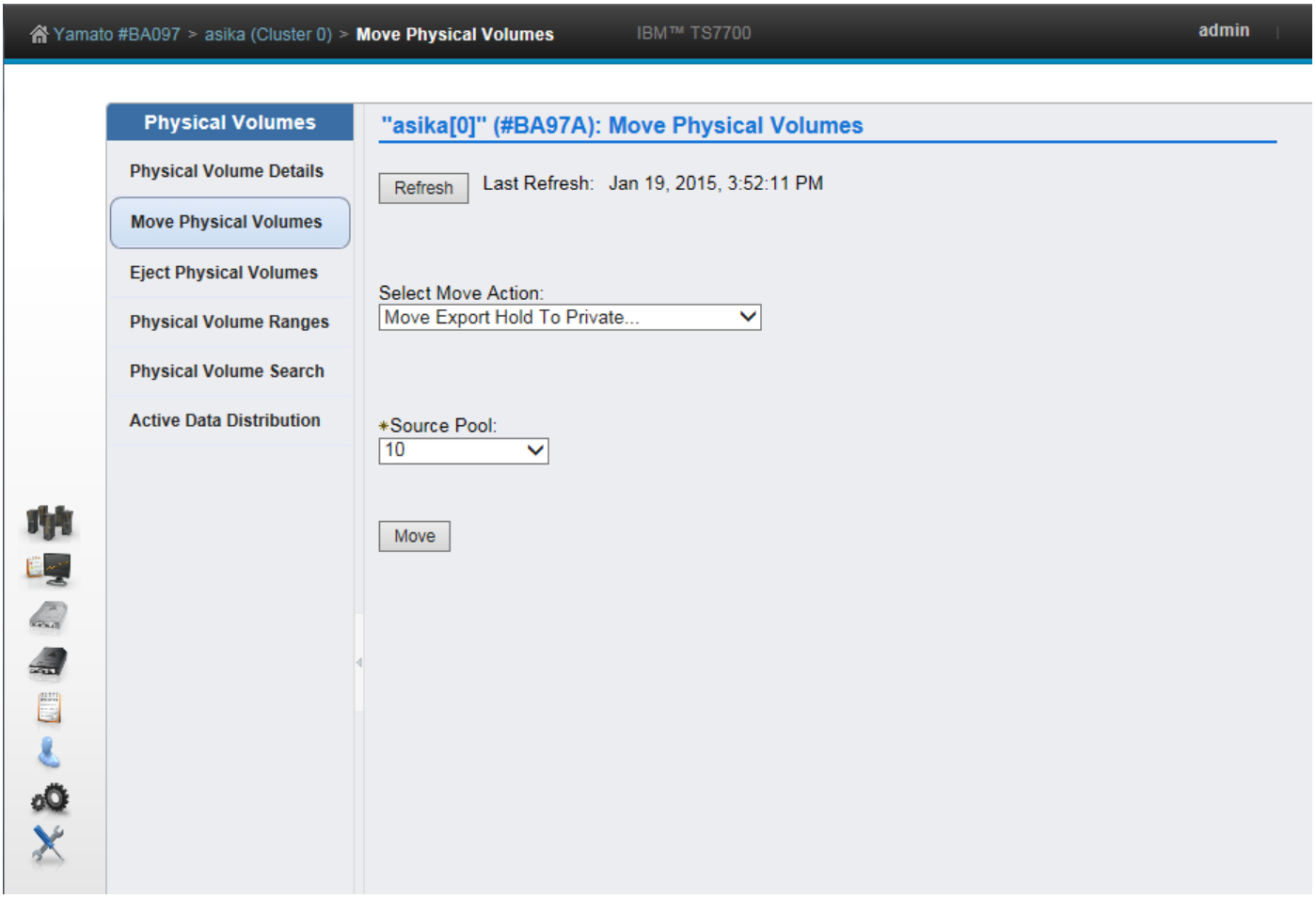
1. Enter the number of physical volumes to export.
2. Click on the Submit button.



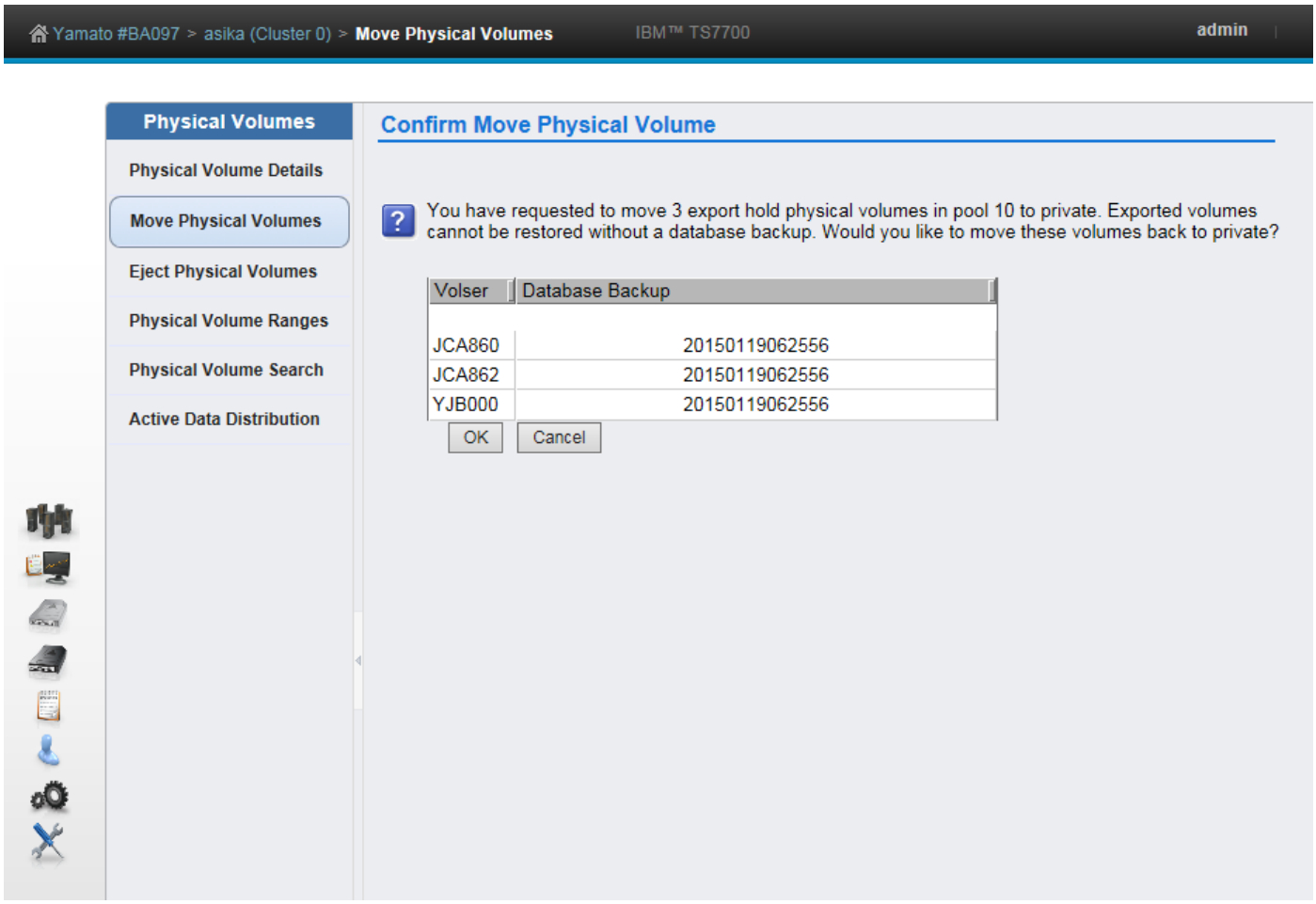
Move Export Hold Volumes Back to Private

Begin by selecting the **Physical Volumes** in **Physical** icon**.** Then select the **Move Physical Volumes**. The figure below shows the Move Physical Volumes panel:

1. From the Select Move Action options choose the Move Export Hold to Private option and then select the source pool that the export hold volume(s) currently reside in.
2. Click on the Move button



A list of up to 500 physical volumes that are currently in export_hold status will be displayed for confirmation for the move. Review the list and select OK to proceed:

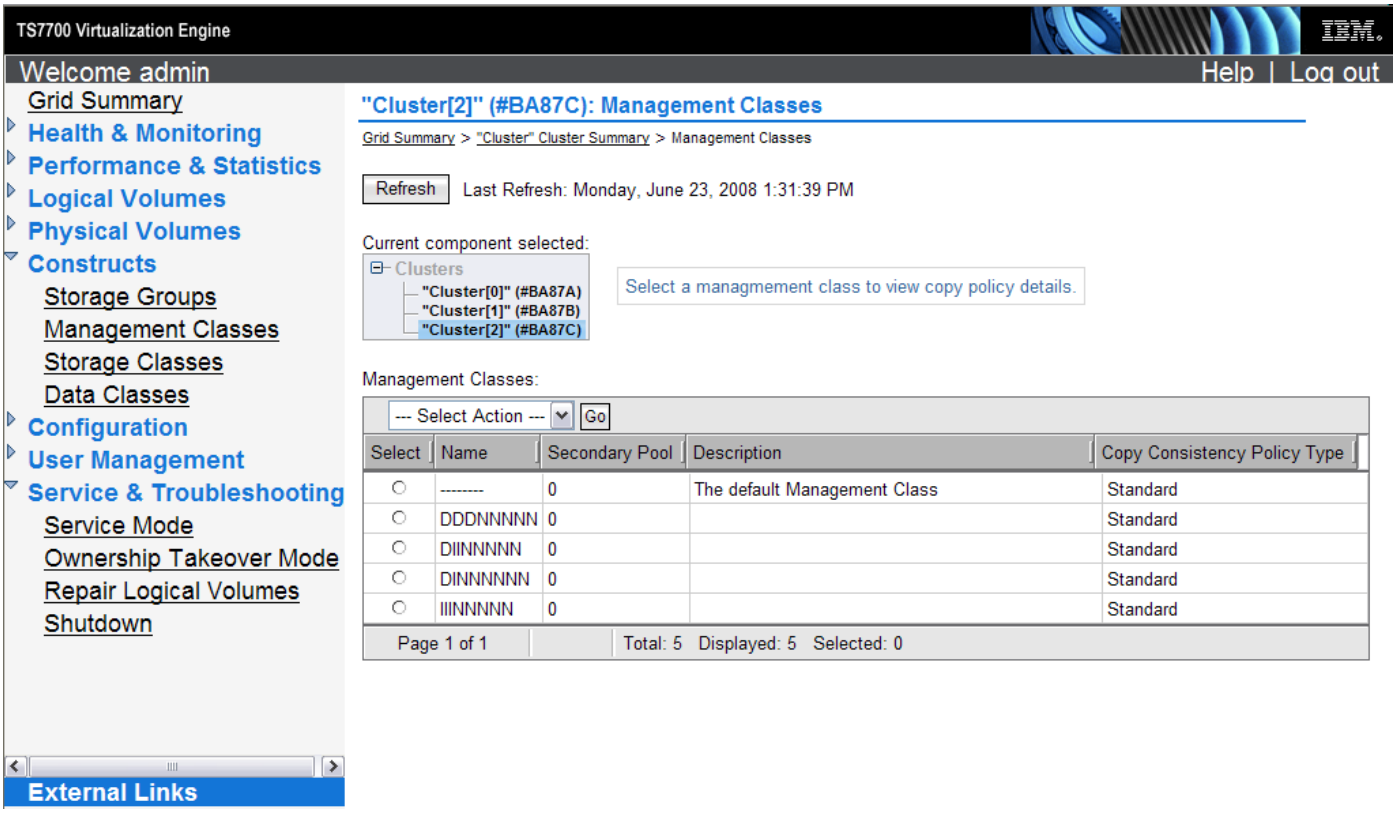


Once the user has selected to OK continue the operation, a task will be started to track the progress of the operation via the Task Tracking mechanism. As with many other functions, the MI will display the final status in the Operation History page, whether it is failed, successfully completed, or still in progress. Therefore, the MI will need to redirect the user to the Operation History page to get their results for this operation. If any failure occurs an Event will be posted. The Event could indicate that not all physical volumes may have been moved successfully and an operator intervention will be posted. Users can also be directed back to the “Move Export Hold to Private” page to review the current list of physical volumes that remain in the pool and to resubmit the Move.

Appendix B – Processes for Systems from 8.5.x.x to 8.21.x.x

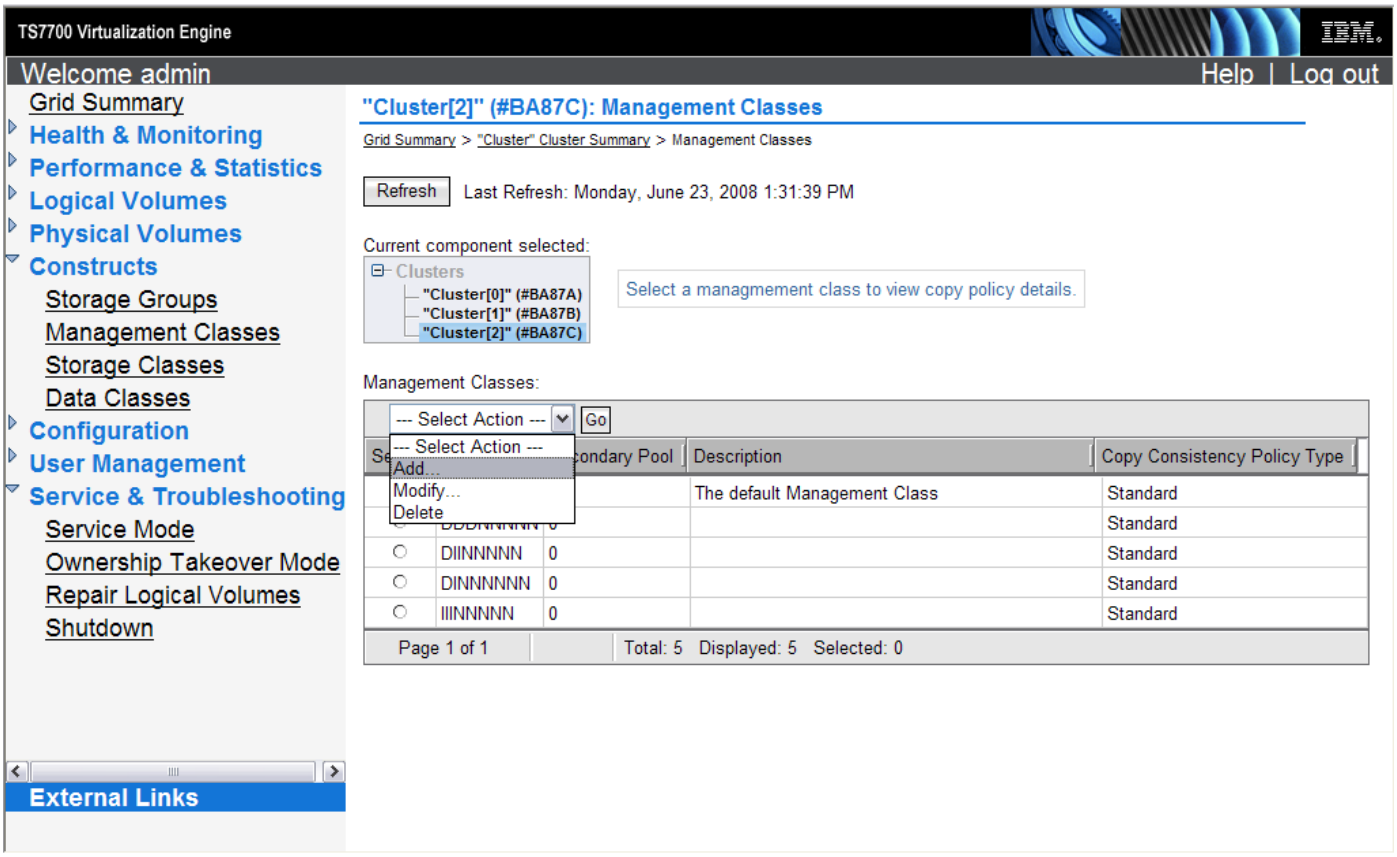
Management Class Definition

Begin by selecting the **Constructs tab.** Then select **Management Classes tab** . The figure below shows the Management Classes panel.

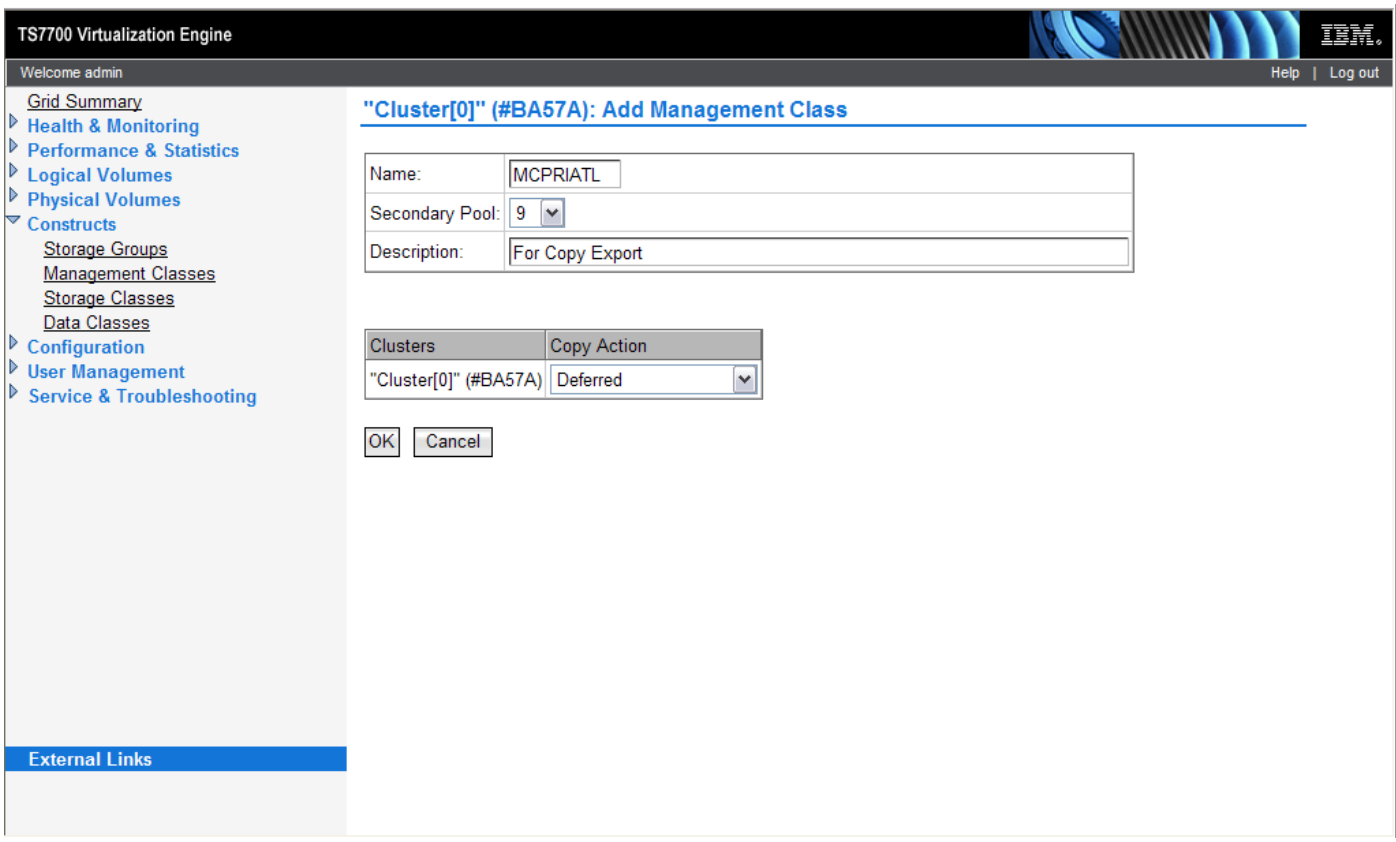


Ÿ To add a management class:

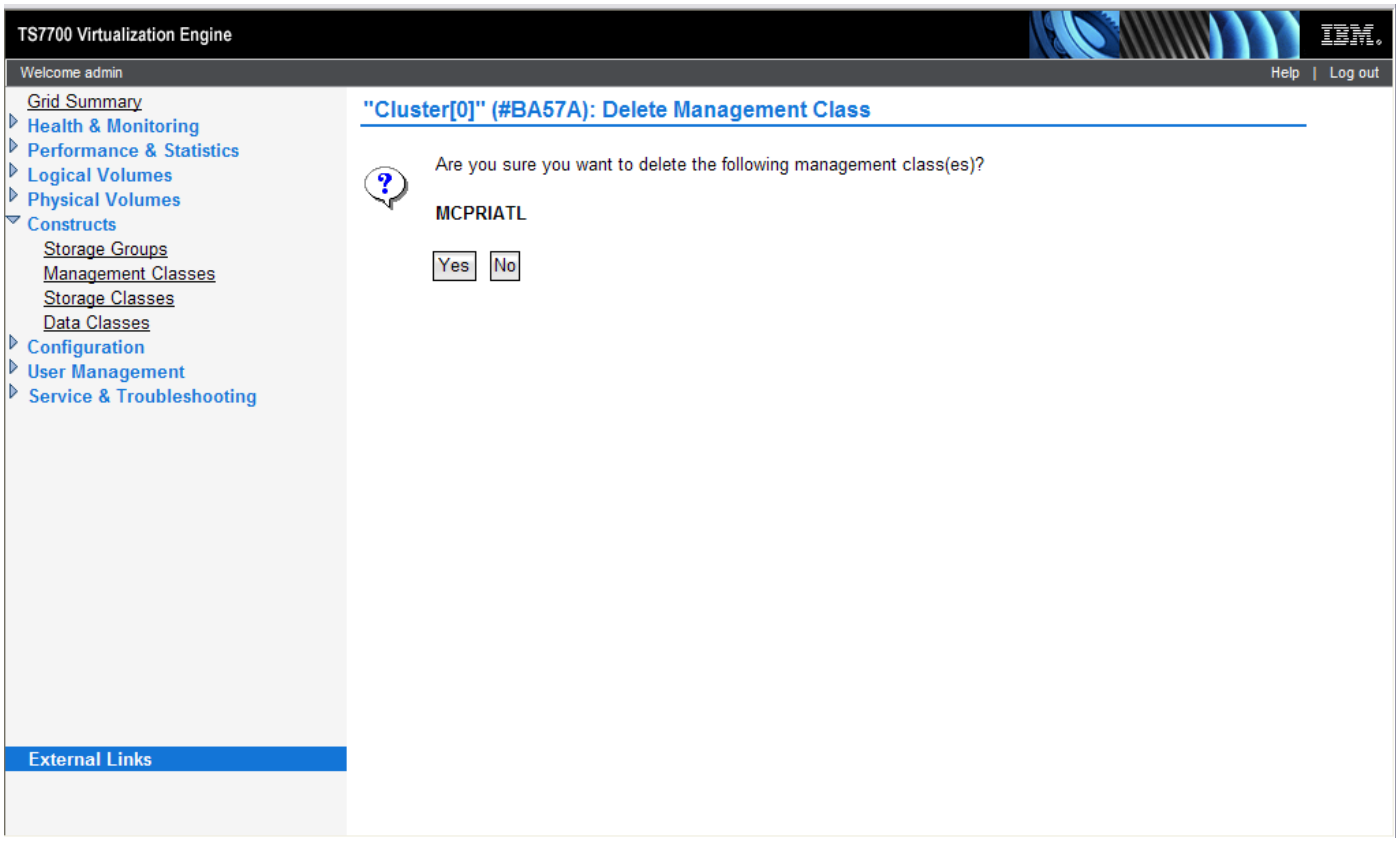
1. Select **Add** from the Select Action options then press **Go**



2. Enter a one to eight-character alphanumeric name in the **Name** field. The name must be unique within the management class construct names defined for the library. In this example, a definition for management class MCPRIATL is being added.
3. Select a **Secondary Pool**. It is recommended that a single secondary pool be associated with a single management class name for copy export use. In this example, pool 9 is being specified,
4. Enter a short description in the **Description** field.
5. If this is a grid configuration, enter **Copy Actions** for the TS7700s. Refer to the *IBM® Virtualization Engine TS7700 Series Best Practices - Copy Consistency Points* whitepaper (WP101230) on Techdocs for a description of Copy Actions.
6. Select the **OK** button to save the management class.

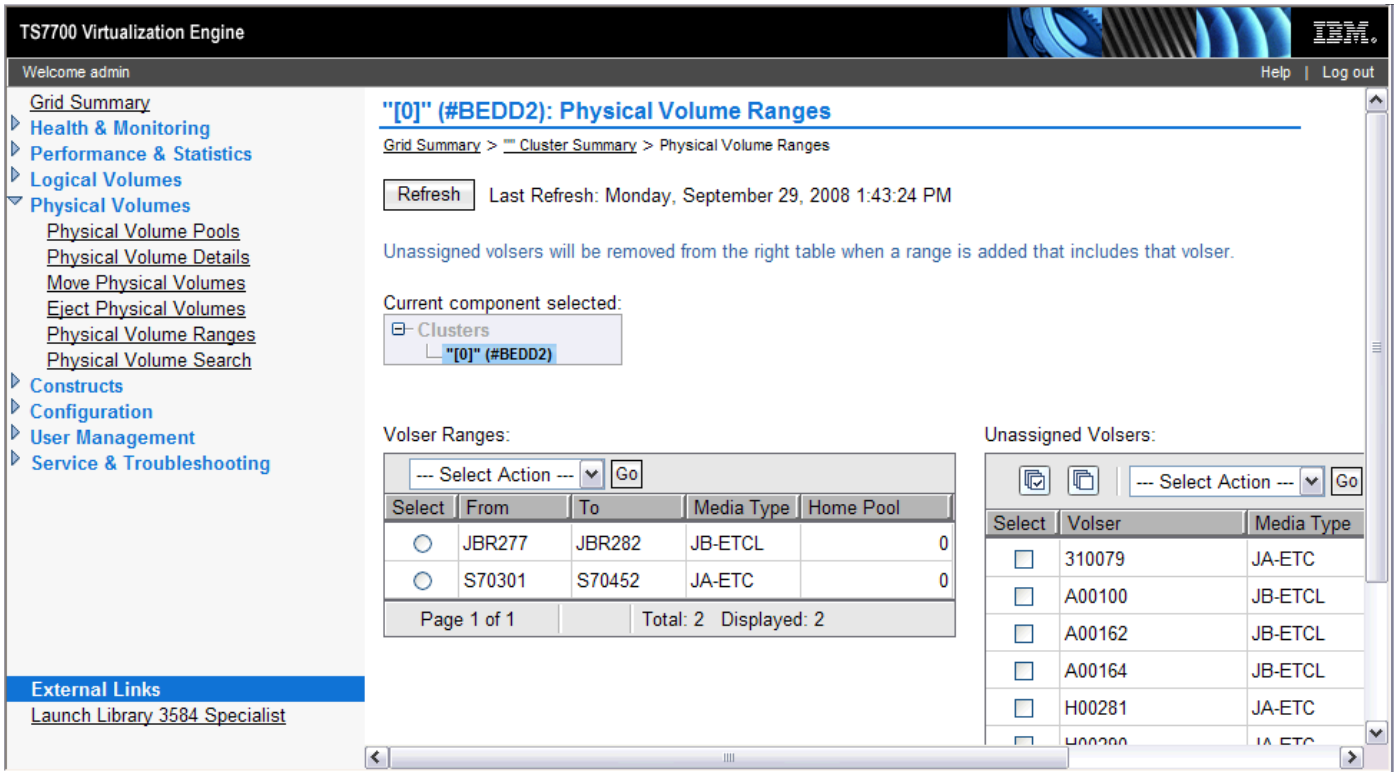


- To modify a management class, select from the list of current management classes listed. Click on the management class you want to modify. Select **Modify** from the Select Action options. Select **Go** to continue. Make modifications to the secondary pool, other attributes and/or description. Select the OK button to save the management class changes.
- To delete a management class, select from the list of current management classes listed. Click on the management class you want to delete. Select **Delete** from the Select Action options. Select **Go** to continue. Select **Yes** to confirm deletion.



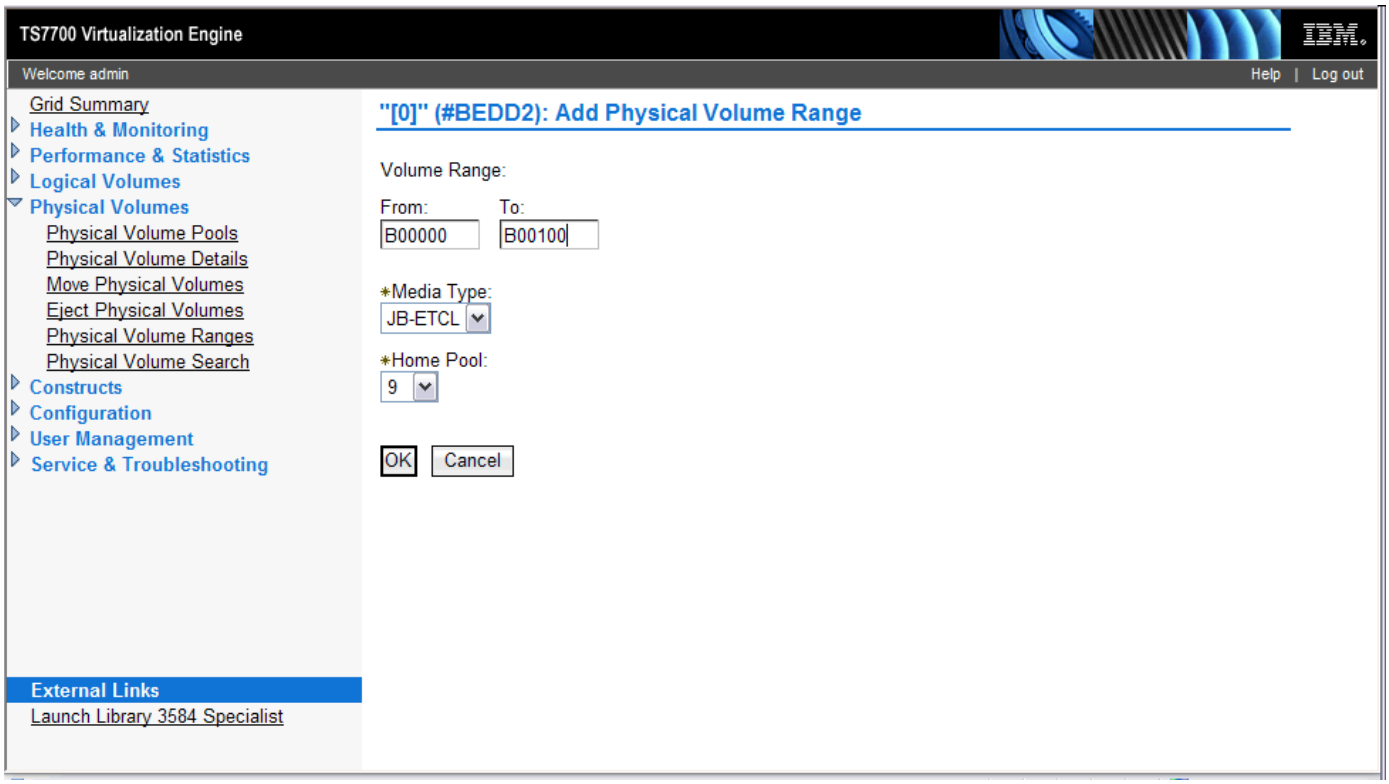
Volser Range Definition

Begin by selecting the **Physical Volumes** tab**.** Then select **Physical Volume Ranges** tab**.** The figure below shows the Physical Volume Ranges panel.



Ÿ To add a range on the TS7700:

1. Select **Add** from the Select Action options then press **Go**



2. Enter volsers in the **From** and **To** fields. In this example, a range from B00000 to B00100 is being defined..
3. Select a **Media Type** compatible with 3592. For this example, the JB media type is being selected.
4. Select the **Home Pool**. For this example, pool 9 is being specified and I want the range of volsers to go to that pool when they are added to the library.
5. Select the **OK** button.

Ÿ To expand a range, click on the range presented in the list, select **Modify** from the Select Action options then press **Go**. Make changes to the from and/or to volser fields, select the **OK** button.

Ÿ To delete a range, click the range presented in the list, select **Delete** from the Select Action options then press **Go**. On the confirmation screen select **YES**.

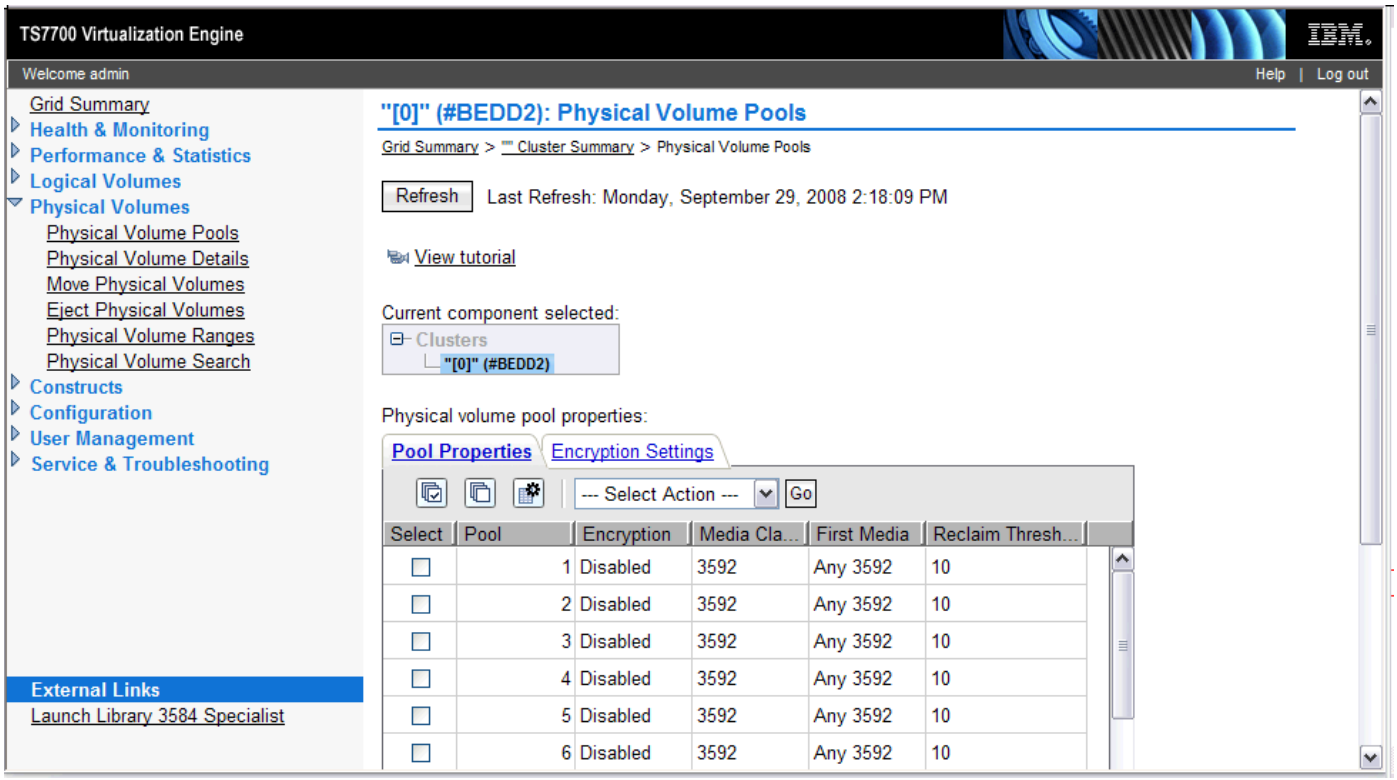
Ÿ If the TS7700 is attached to a 3584 library then set up the Cartridge Assignment Policies per the instructions in Appendix D for the same ranges

Ÿ If the TS7700 is attached to a 3494 library then setup the Volser Ranges on the 3494 using the instructions in Appendix C Volser Range Definition

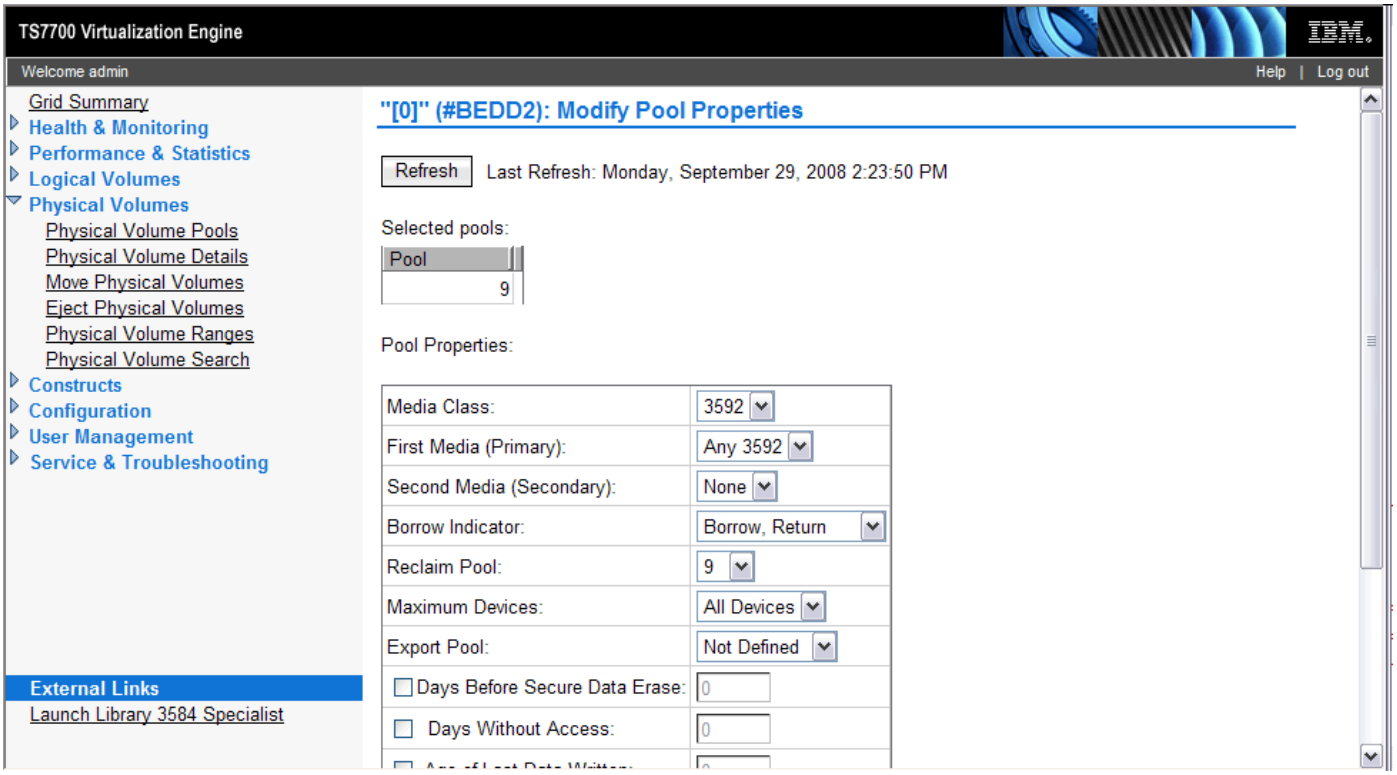
Manage Physical Volume Pool Properties

Begin by selecting the **Physical Volumes** tab**.** Then select **Physical Volume Pools** tab**.** The figure below shows the Physical Volume Pools panel.

2. Check the box beside the pool to be modified and select **Properties** from the Select Action options then press **Go**



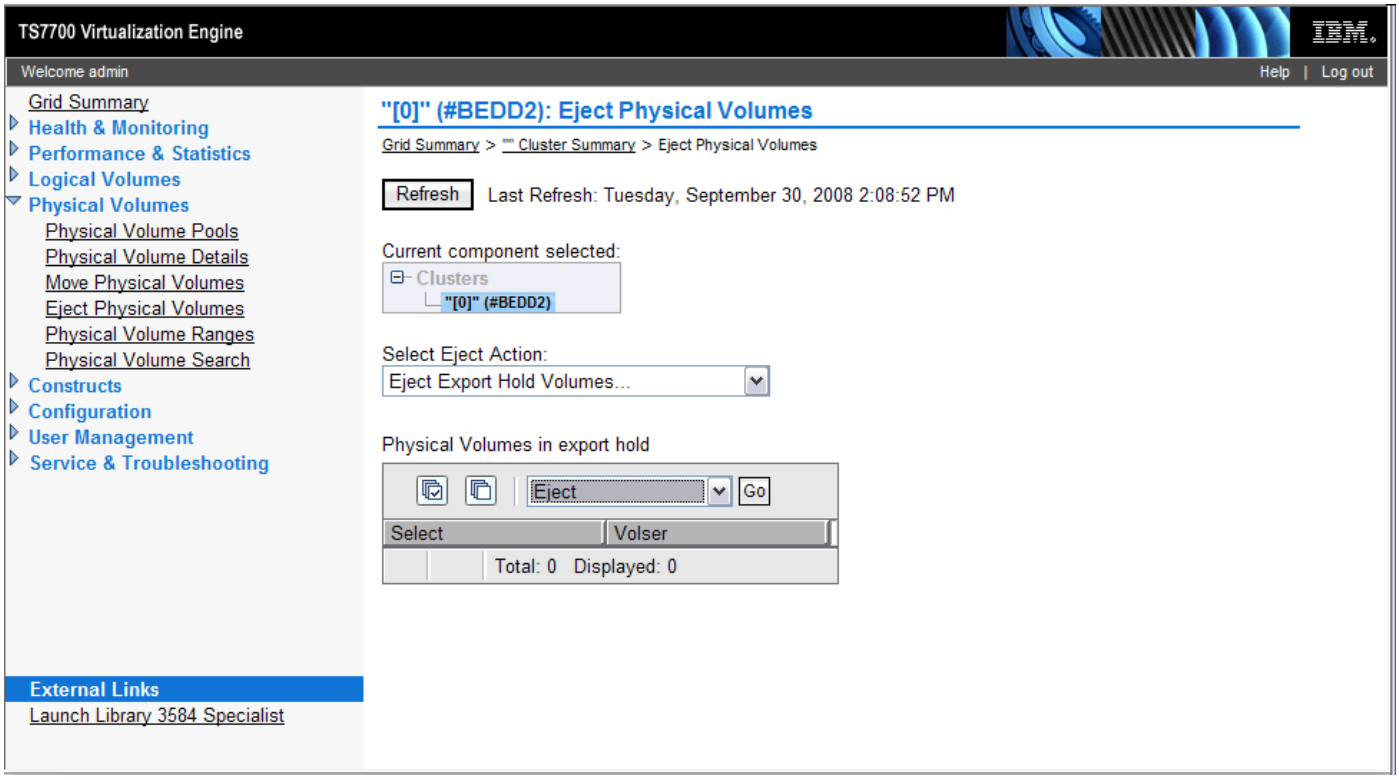
- To modify the pool properties:
  1. On the Export Pool field select Copy Export from the pull down
     Note: You will not be able to change this pool setting if the pool has already been associated with a storage group name. Associating a pool with a storage group name makes that pool a primary storage pool and a primary storage pool cannot be use for a copy export pool.
  2. Select a **Borrow Indicator.** The setting defines if the pool borrows physical volumes from the common scratch pool (Pool 00) and whether they are returned to the common scratch pool when reclaimed. For this example, the pool will borrow and return all volumes assigned to it.
  3. Select the **1st & 2nd Media** types to be borrowed/returned from/to the common scratch pool (if borrow was indicated).
  4. Select the **Reclaim Pool.** The default is to the same pool. If the reclaim pool is modified, copy export disaster recovery capabilities can be compromised. If there is a need to modify the reclaim pool designated for the copy export pool, the reclaim pool **CANNOT** be set to the same value as the primary pool or the reclaim pool designated for the primary pool. If the reclaim pool for the copy export pool is the same as either of the other two pools mentioned, then primary and backup copies of a logical volume may exist on the same physical media. If the reclaim pool for the copy export pool is modified, it is the customer's responsibility to copy export volumes from the reclaim pool.
  5. Select the **Maximum Devices.** Leave at the default of All Devices unless you want to limit the number of drives that will be used for copying data from the cache to physical volumes. This setting specifies how many physical devices the TS7700 may use concurrently when copying data from cache to the pool. If you set the default or a large value here, you may have many copy exported physical volumes with small amount of data on each. A value of 1 minimizes the number of physical volumes used for copy export, but the time to copy data from cache will take longer. The best value depends on the amount of data exported. For example, if you estimate you would normally export about 8.0TB data and use JC media, the data could fit on as few as 2 physical volumes, so you may want to set this field to 2. It is possible that an additional volume may be used depending on drive and physical volume availability when data is copied from the cache to physical tapes during a copy export operation.
  6. Set up the reclamation policies by entering values in the **Days without Access, Age of Last Data Written, Days Without Data Inactivation** and **Maximum Active Data** fields. A value of 1 to 365 days may be specified. If you do not want a policy to be included, set the field to 0. In this example, all reclaim values have been set to 0. Maximum Active Data defaults to 5%
  7. Let Reclaim Threshold Percentage default to 10%.
  8. Select the **OK** button.



Manage Export Hold Volumes

Begin by selecting the **Physical Volumes** tab**.** Then select the Eject Physical Volumes tab. The figure below shows the Eject Physical Volumes panel:

3. From the Select Action options choose the Eject Export Hold option
4. Put a check next to the volumes you want to eject and choose **Eject** from the action pulldown then choose **Go**

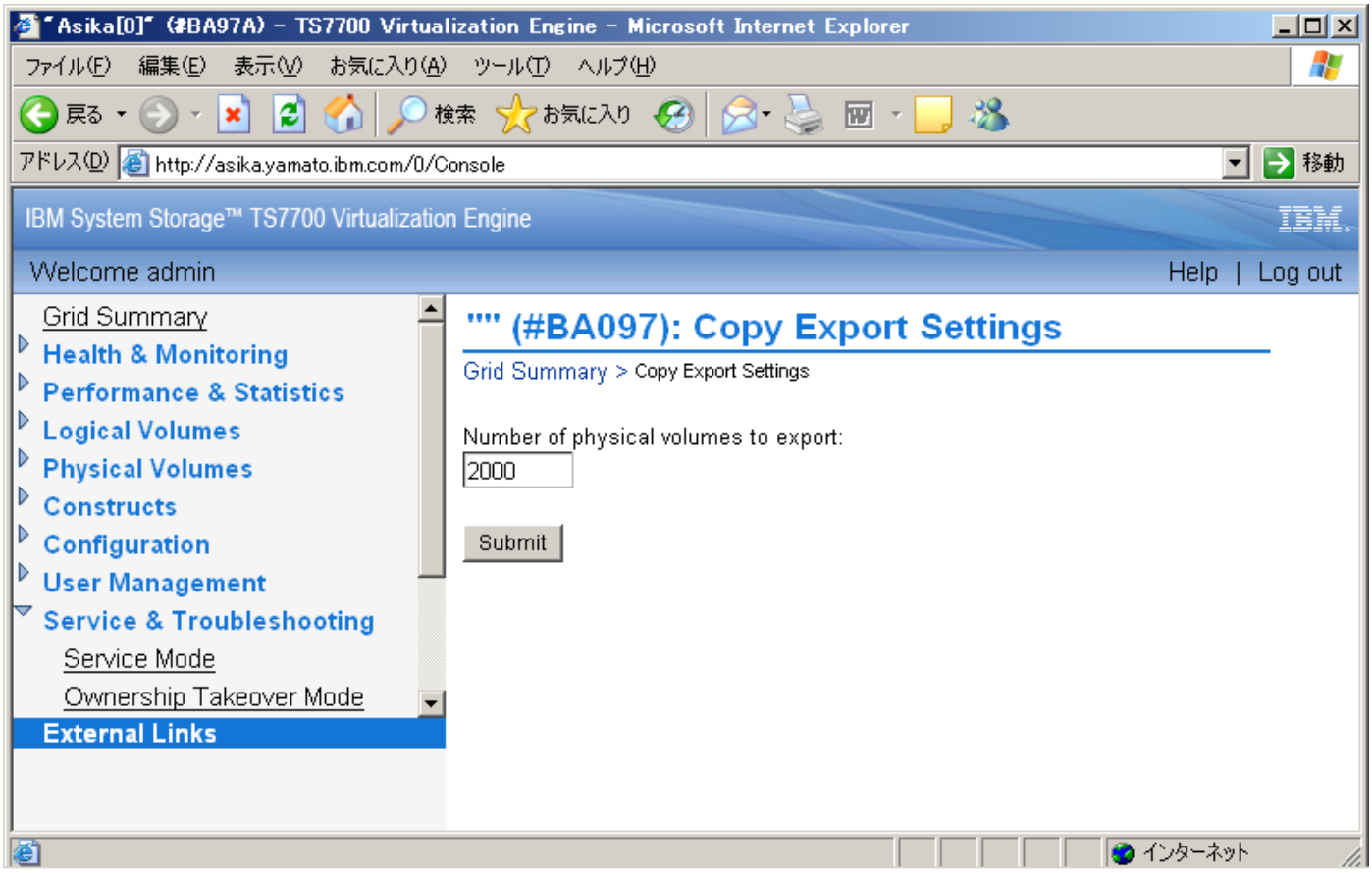


.

Copy Export Settings

Begin by selecting the **Service & Troubleshooting** tab**.** Then select **Copy Export Settings tab.** The figure below shows the Copy Export Settings panel:

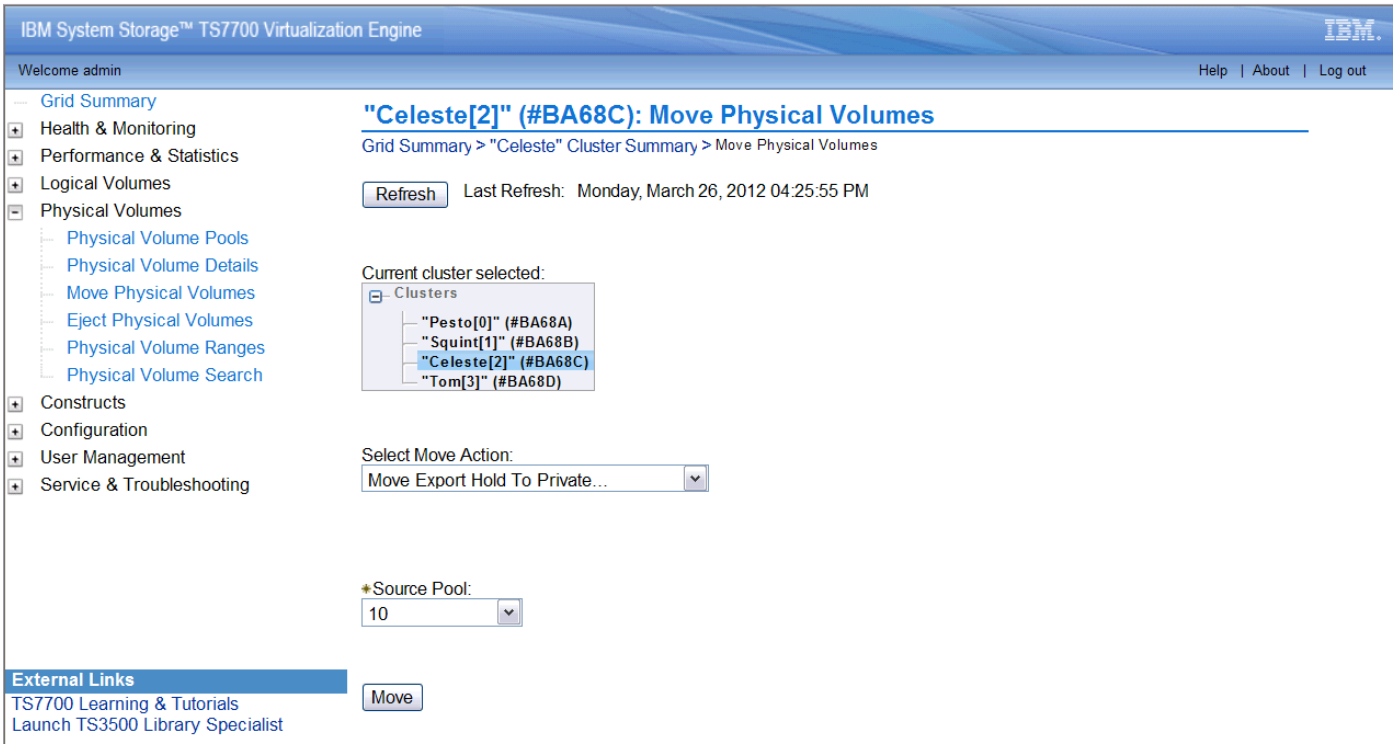
1. Enter the number of physical volumes to export.
2. Click on the Submit button.



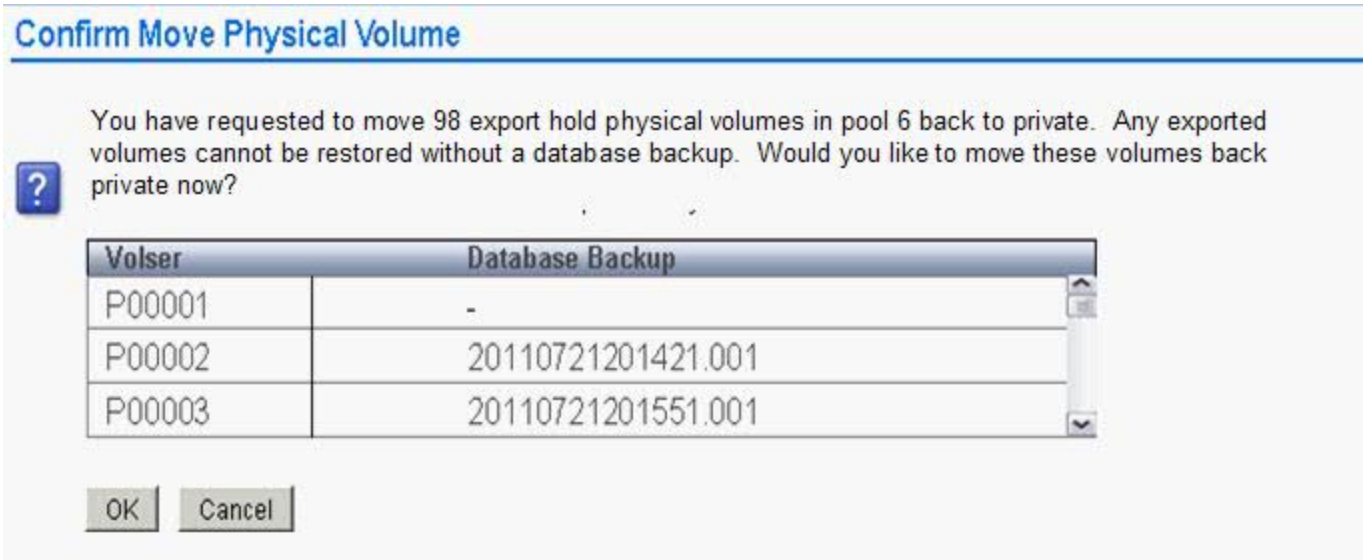
Move Export Hold Volumes Back to Private

Begin by selecting the **Physical Volumes** tab**.** Then select the Move Physical Volumes. The figure below shows the Move Physical Volumes panel:

1. From the Select Move Action options choose the Move Export Hold to Private option and then select the source pool that the export hold volume(s) currently reside in.
2. Click on the Move button



A list of up to 500 physical volumes that are currently in export_hold status will be displayed for confirmation for the move. Review the list and select OK to proceed:

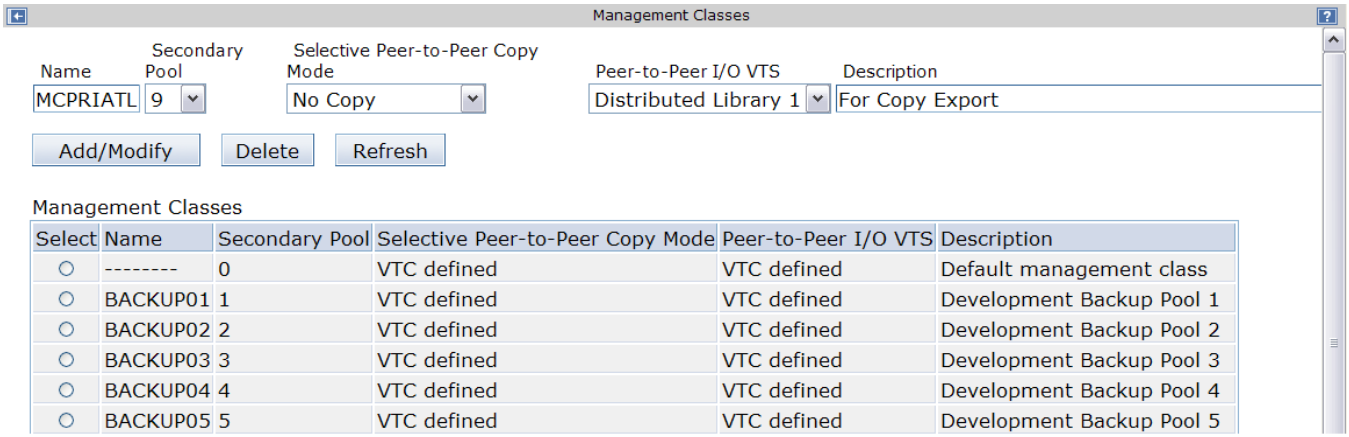


Once the user has selected to OK continue the operation, a task will be started to track the progress of the operation via the Task Tracking mechanism. As with many other functions, the MI will display the final status in the Operation History page, whether it is failed, successfully completed, or still in progress. Therefore, the MI will need to redirect the user to the Operation History page to get their results for this operation. If any failure occurs an Event will be posted. The Event could indicate that not all physical volumes may have been moved successfully and an operator intervention will be posted. Users can also be directed back to the "Move Export Hold to Private" page to review the current list of physical volumes that remain in the pool and to resubmit the Move.

Appendix C – Processes on Pre 8.5.x.x Systems

Management Class Definition

Begin by selecting the **Manage Constructs** menu from the **Administer VTS x** (where x is the TS7700 you are using) menu. Then select **Management Classes**. The figure below shows the Management Classes panel.



Note: In a Grid configuration that is to be used with copy export, just one of the TS7700 should be set up with a management class defined to create a second copy of the data that will be exported.

Note: If there is more than one TS7700 or VTS installed in the library, the relationship of the management class construct name to a secondary pool number applies to both TS7700s/VTSs.

Ÿ To add a management class:

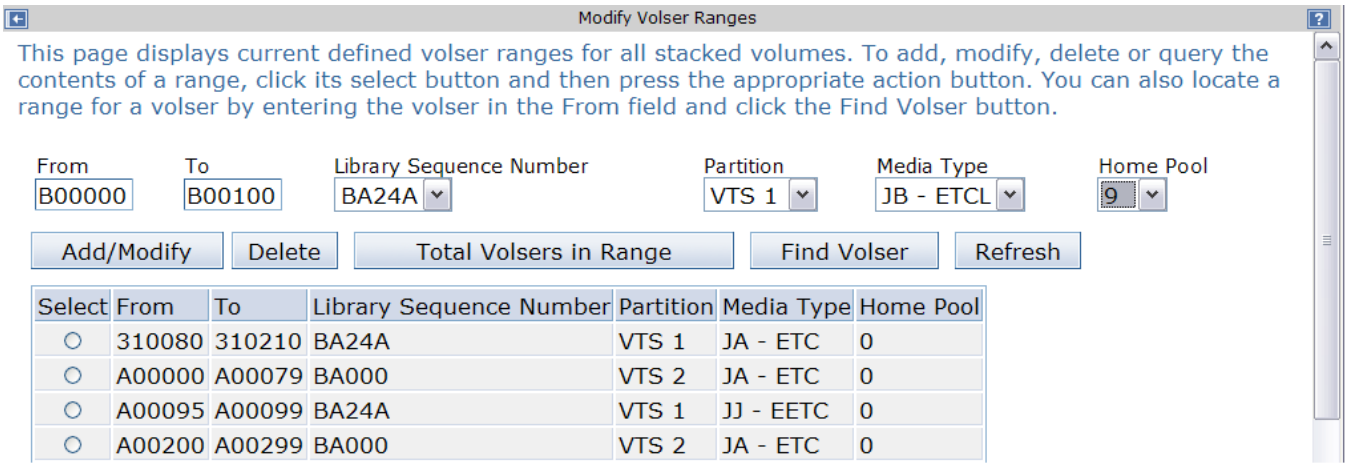
1. Enter a one to eight-character alphanumeric name in the **Name** field. The name must be unique within the management class construct names defined for the library. In this example, a definition for management class MCPRIATL is being added.
2. Select a **Secondary Pool**. A secondary pool can be associated with more than one management class name, but that is not recommended if the secondary pool is to be used for copy export. In this example, pool 9 is being specified,
3. Enter a short description in the **Description** field.
4. If this is a grid configuration, enter Copy Consistency PointsActions for the TS7700s attached to the Library Manager. Refer to the *IBM® Virtualization Engine TS7700 Series Best Practices - Copy Consistency Points* whitepaper (WP101230) on Techdocs for a description of Copy Consistency PointsActions.
5. Select Add/Modify

Ÿ To modify a management class, select from the list of current management classes listed. Click on the management class you want to modify. Make modifications to the secondary pool, other attributes and/or description. Select the **Add/Modify** button.

Ÿ To delete a management class, select from the list of current management classes listed. Click on the management class you want to delete. Select the **Delete** button.

Volser Range Definition

Begin by selecting **Modify Volser Ranges** from the **Administer Library Manager** menu. The figure below shows the modify volser ranges window.



Ÿ To add a range on the library manager:

1. Enter volsers in the **From** and **To** fields. In this example, a range from B00000 to B00100 is being defined.
2. Specify the library the volser range is to be associated with by selecting the library sequence number.
3. Select a **Media Type** compatible with 3592. Make sure you are selecting the media type for the correct TS7700 if there is more than one in the library. An important consideration for the media type is to select one that is compatible with the physical drives of the TS7700 that would be used for recovery. For this example, the JB media type is being selected.
4. Select the **Home Pool**. For this example, pool 9 is being specified and I want the range of volsers to go to that pool when they are added to the library.
5. Select the **Add/Modify** button.

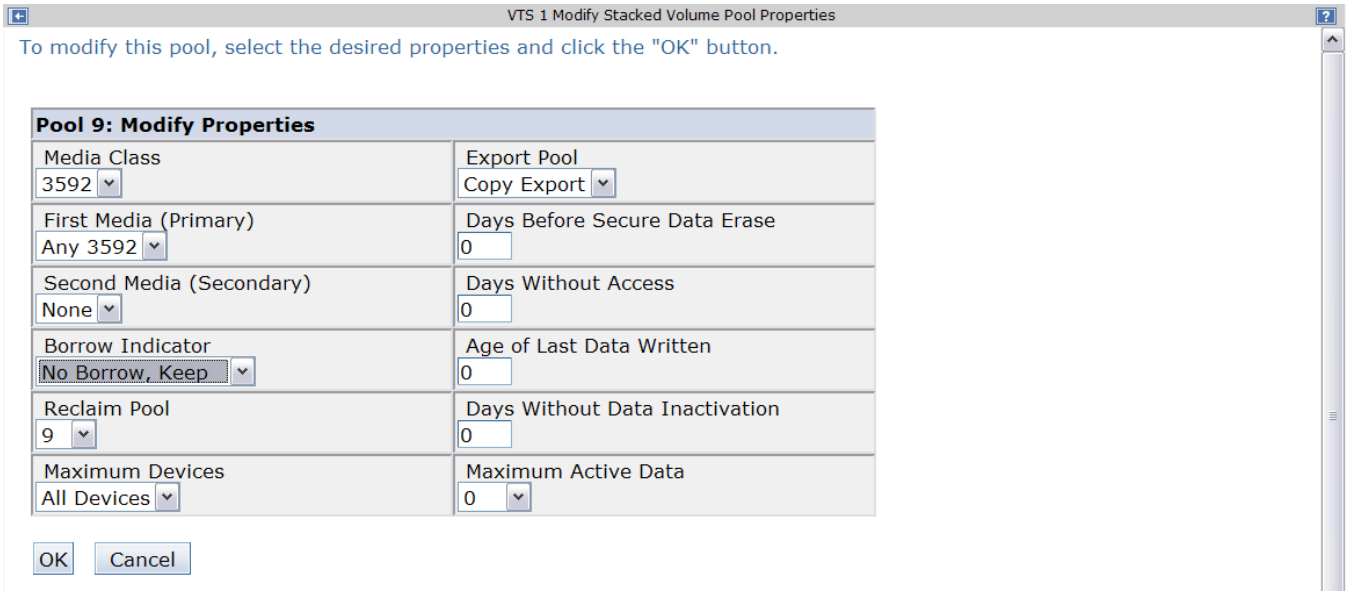
Ÿ To expand a range, click on the range presented in the list. Make changes to the from and/or to volser fields, select the **Add/Modify** button.

Ÿ To delete a range, click the range presented in the list, the select the **Delete** button.

Ÿ If the TS7700 is attached to a 3584 library then set up the Cartridge Assignment Policies in Appendix D for the same ranges.

Manage Storage Pool Properties

Begin by selecting **Manage storage pool properties** from the **Administer VTS x** (where x is the TS7700 you are using) menu. Then click on the pool to be modified. This will then display the **Modify Stacked Volume Pool Properties** panel or the pool as shown below.



Ÿ To modify pool properties

1. Select Copy Export through the **Export Pool** pulldown.

Note: You will not be able to change this pool setting if the pool has already been associated with a storage group name. Associating a pool with a storage group name makes that pool a primary storage pool and a primary storage pool cannot be use for a copy export pool.

2. Select a **Borrow Indicator.** The setting defines if the pool borrows physical volumes from the common scratch pool (Pool 00) and whether they are returned to the common scratch pool when reclaimed. For this example, the pool will not borrow and will keep all volumes assigned to it.

3. Select the **1st & 2nd Media** types to be borrowed/returned from/to the common scratch pool (if borrow was indicated).

4. Select the **Reclaim Pool.** The default is to the same pool. If the reclaim pool is modified, copy export disaster recovery capabilities can be compromised. If there is a need to modify the reclaim pool designated for the copy export pool, the reclaim pool **CANNOT** be set to the same value as the primary pool or the reclaim pool designated for the primary pool. If the reclaim pool for the copy export pool is the same as either of the other two pools mentioned, then primary and backup copies of a logical volume may exist on the same physical media. If the reclaim pool for the copy export pool is modified, it is the customer's responsibility to copy export volumes from the reclaim pool.

5. Select the **Maximum Devices.** Leave at the default of All Devices unless you want to limit the number of drives that will be used for copying data from the cache to physical volumes. This setting specifies how many physical devices the TS7700 may use concurrently when copying data from cache to the pool. If you set the default or a large value here, you may have many copy exported physical volumes with small amount of data on each. A value of 1 minimizes the number of physical volumes used for copy export, but the time to copy data from cache will take longer. The best value

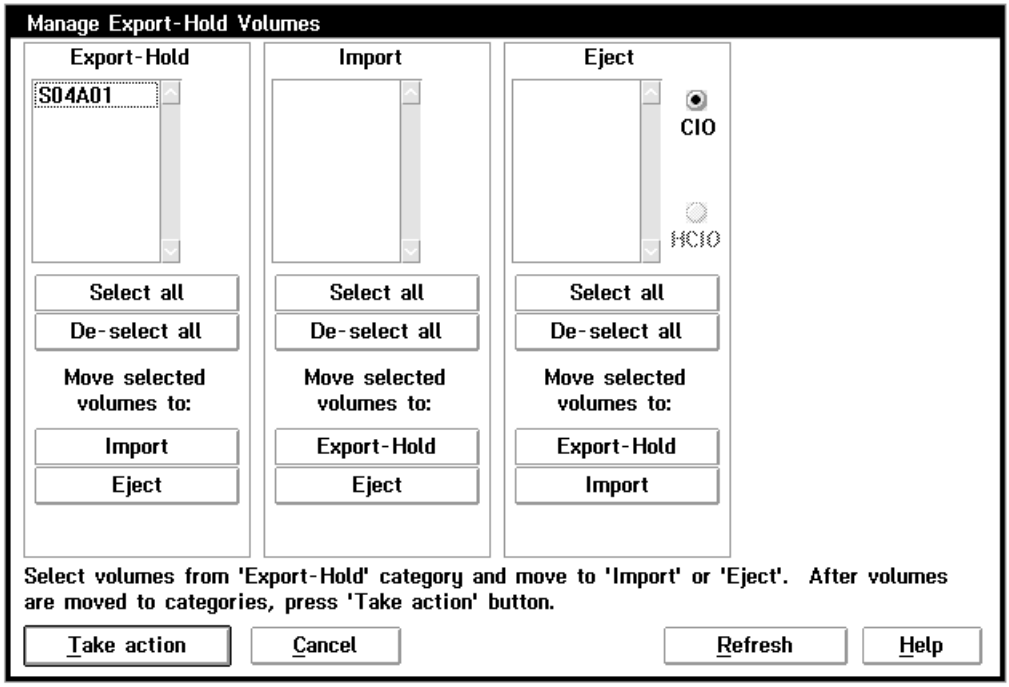
depends on the amount of data exported. For example, if you estimate you would normally export about 600GB data and use JA media, the data could fit on as few as 2 physical volumes, so you may want to set this field to 2. It is possible that an additional volume may be used depending on drive and physical volume availability when data is copied from the cache to physical tapes during a copy export operation.

6. Set up the reclamation policies by entering values in the **Days without Access, Age of Last Data Written, Days Without Data Inactivation** and **Maximum Active Data** fields. A value of 1 to 365 days may be specified. If you do not want a policy to be included, set the field to 0. In this example, all reclaim values have been set to 0. Note: these fields do not apply to offsite reclamation.

7. Select the **OK** button.

Manage Export Hold Volumes

The Library Manager console dialog box, **Manage Export-Hold Volumes**, allows an operator to move the copy exported volumes from the export-hold category to the eject category which will cause the volumes to be placed in the Convenience I/O station of the library.

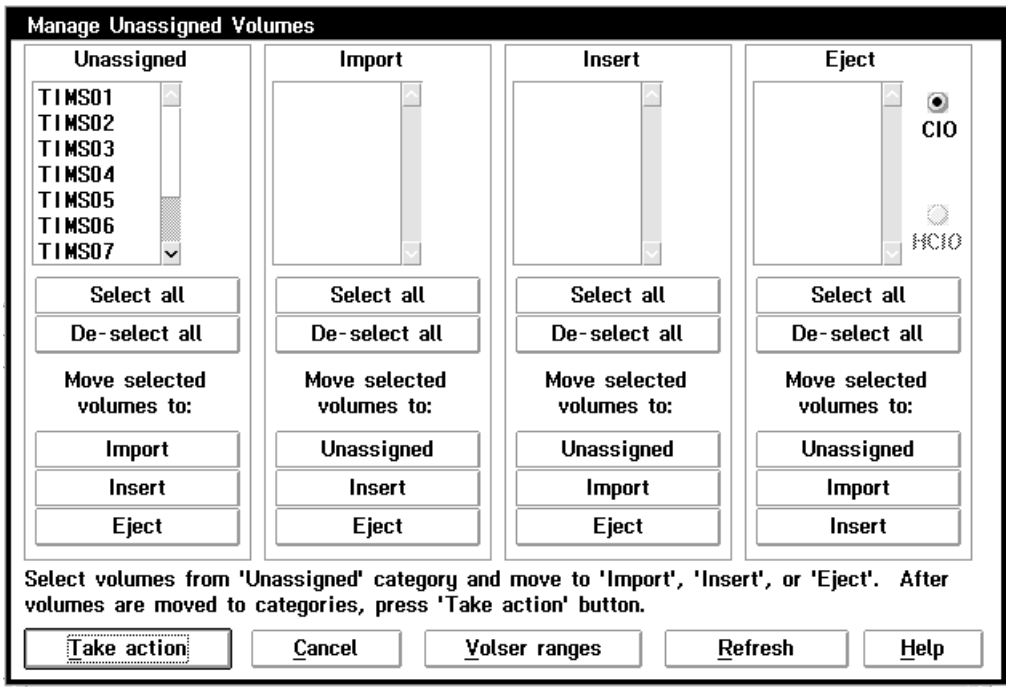


Highlight the Export Hold volumes and press the **Eject** button followed by the **Take Action** button.

Note: Although the **Manage Export-Hold Volumes** panel allows the movement of volumes to the import category, that should never be done for physical volumes exported as part of a copy export operation. If it is decided to return them to the control of the TS7700, they should be ejected and then inserted into the I/O station. If a mistake is made and volumes are moved to the import category, use the **Manage Import Volumes** panel to select and then eject the physical volumes.

Re-Inserting Copy Export Volumes

For Library Manager code levels earlier than 535.19, added physical volume will become unassigned volumes and you will need to use the **Manage Unassigned Volumes** panel on the library manager to have them returned to the TS7700.



Highlight the Unassigned volumes and press the **Insert** button followed by the **Take Action** button

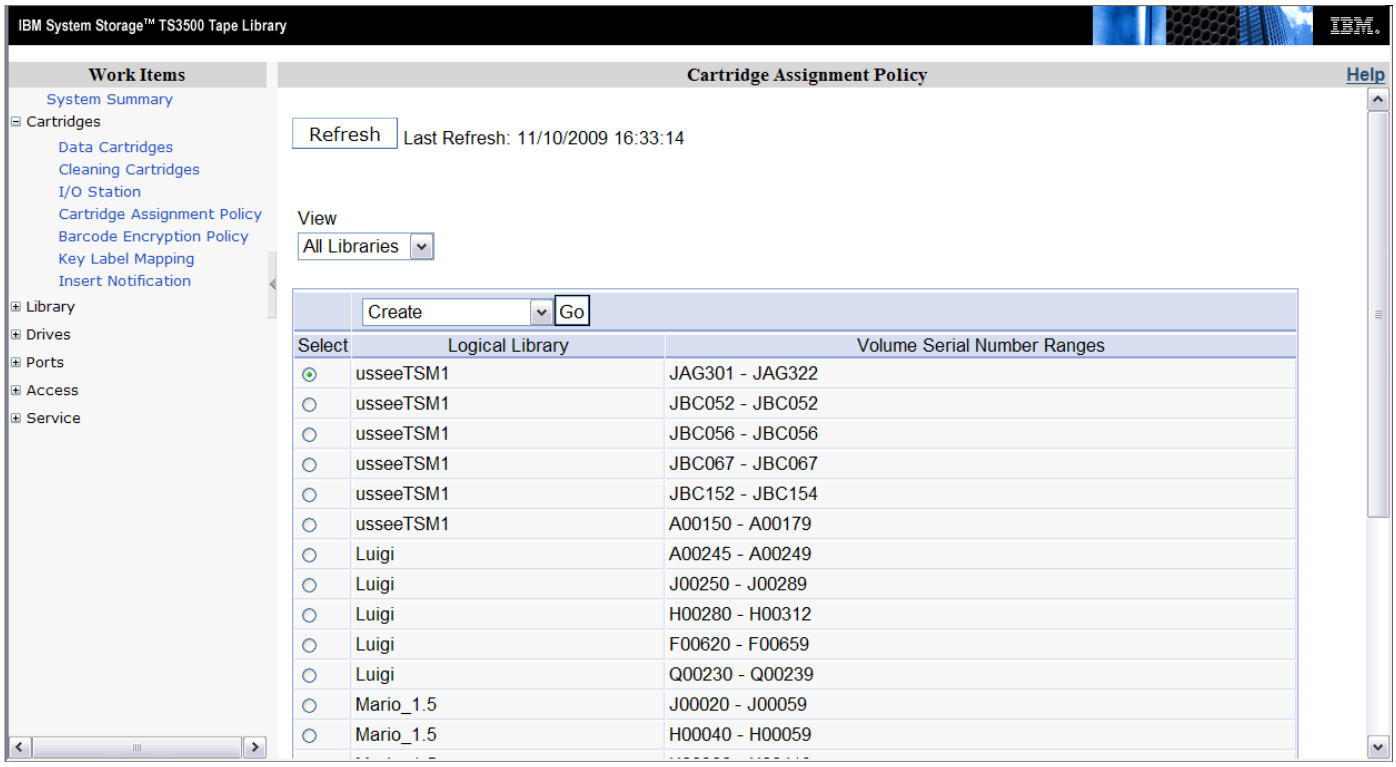
The selected volumes are then added to the insert category and the TS7700 will see that they are volumes it owns and return them to the pool they were in. Their state is changed to READ-WRITE and if they have no active data on them, to the empty status as well

Note: With library manager level 535.19 and higher, physical volumes added to the library are directly added to the insert category for the TS7700.

Appendix D – Processes for 3584 Attached Libraries

Cartridge Assignment Policy Definition

Select Cartridges tab. Then select the Cartridge Assignment Policy tab. The figure below shows the Cartridge Assignment Policy panel. **Go**



1. From the **View** pull down select the logical library that you are attached to
2. Select **Create** from the pull down selection then press **Go**
3. Enter the Volume Serial Number Start and End then press **Apply**

References

DFSMS: Using Magnetic Tapes , SC26-7412

DFSMS Object Access Method Planning, Installation, and Storage Administration Guide for Tape Libraries, SC35-0427

White paper - IBM Virtualization Engine TS7700 Series z/OS Host Command Line Request User's Guide (latest version)

White paper - IBM Virtualization Engine TS7700 Series Bulk Volume Information Retrieval Function User's Guide (latest version)

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