



Recover from storage volume failure where system drive is intact

StorageGRID

NetApp

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Recover from storage volume failure where system drive is intact

Recover from storage volume failure where system drive is intact: Overview

You must complete a series of tasks to recover a software-based Storage Node where one or more storage volumes on the Storage Node have failed, but the system drive is intact. If only storage volumes have failed, the Storage Node is still available to the StorageGRID system.



This recovery procedure applies to software-based Storage Nodes only. If storage volumes have failed on an appliance Storage Node, use the appliance procedure instead: [Recover appliance Storage Node](#).

This recovery procedure includes the following tasks:

- [Review warnings for storage volume recovery](#)
- [Identify and unmount failed storage volumes](#)
- [Recover the volumes and rebuild the Cassandra database](#)
- [Restore object data](#)
- [Check the storage state](#)

Warnings for storage volume recovery

Before recovering failed storage volumes for a Storage Node, review the following warnings.

The storage volumes (or rangedbs) in a Storage Node are identified by a hexadecimal number, which is known as the volume ID. For example, 0000 is the first volume and 000F is the sixteenth volume. The first object store (volume 0) on each Storage Node uses up to 4 TB of space for object metadata and Cassandra database operations; any remaining space on that volume is used for object data. All other storage volumes are used exclusively for object data.

If volume 0 fails and needs to be recovered, the Cassandra database might be rebuilt as part of the volume recovery procedure. Cassandra might also be rebuilt in the following circumstances:

- A Storage Node is brought back online after having been offline for more than 15 days.
- The system drive and one or more storage volumes fails and is recovered.

When Cassandra is rebuilt, the system uses information from other Storage Nodes. If too many Storage Nodes are offline, some Cassandra data might not be available. If Cassandra has been rebuilt recently, Cassandra data might not yet be consistent across the grid. Data loss can occur if Cassandra is rebuilt when too many Storage Nodes are offline or if two or more Storage Nodes are rebuilt within 15 days of each other.

-  If more than one Storage Node has failed (or is offline), contact technical support. Don't perform the following recovery procedure. Data loss could occur.
-  If this is the second Storage Node failure in less than 15 days after a Storage Node failure or recovery, contact technical support. Rebuilding Cassandra on two or more Storage Nodes within 15 days can result in data loss.
-  If more than one Storage Node at a site has failed, a site recovery procedure might be required. See [How technical support recovers a site](#).
-  If ILM rules are configured to store only one replicated copy and the copy exists on a storage volume that has failed, you will not be able to recover the object.
-  If you encounter a Services: Status - Cassandra (SVST) alarm during recovery, see [Recover failed storage volumes and rebuild Cassandra database](#). After Cassandra is rebuilt, alarms should clear. If alarms don't clear, contact technical support.

Related information

[Warnings and considerations for grid node recovery](#)

Identify and unmount failed storage volumes

When recovering a Storage Node with failed storage volumes, you must identify and unmount the failed volumes. You must verify that only the failed storage volumes are reformatted as part of the recovery procedure.

Before you begin

You are signed in to the Grid Manager using a [supported web browser](#).

About this task

You should recover failed storage volumes as soon as possible.

The first step of the recovery process is to detect volumes that have become detached, need to be unmounted, or have I/O errors. If failed volumes are still attached but have a randomly corrupted file system, the system might not detect any corruption in unused or unallocated parts of the disk.

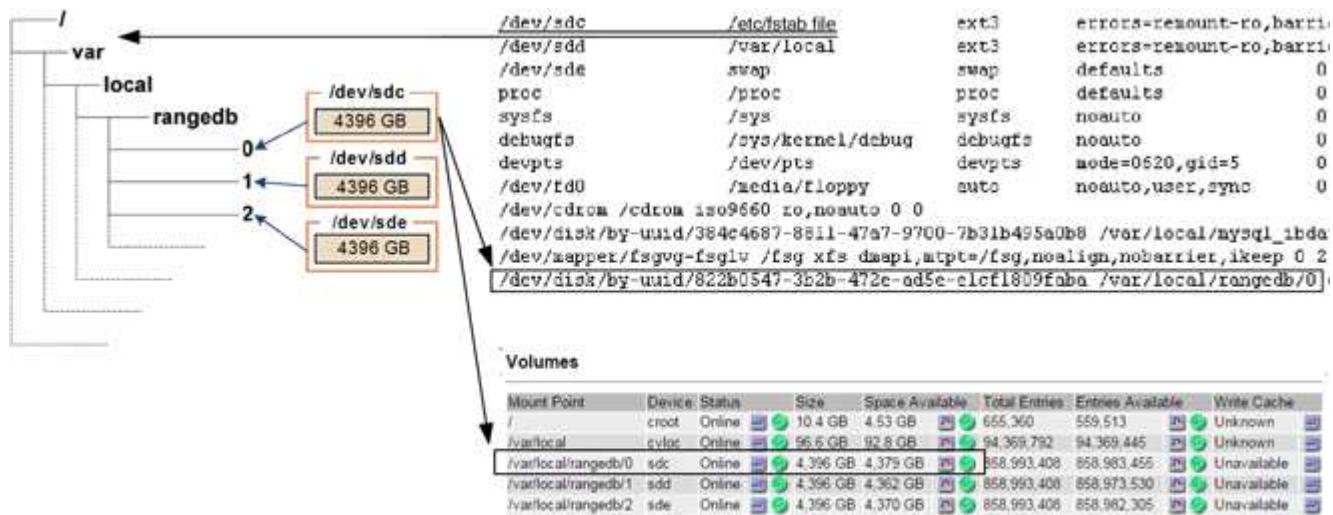
-  You must finish this procedure before performing manual steps to recover the volumes, such as adding or re-attaching the disks, stopping the node, starting the node, or rebooting. Otherwise, when you run the `reformat_storage_block_devices.rb` script, you might encounter a file system error that causes the script to hang or fail.
-  Repair the hardware and properly attach the disks before running the `reboot` command.
-  Identify failed storage volumes carefully. You will use this information to verify which volumes must be reformatted. After a volume has been reformatted, data on the volume can't be recovered.

To correctly recover failed storage volumes, you need to know both the device names of the failed storage

volumes and their volume IDs.

At installation, each storage device is assigned a file system universal unique identifier (UUID) and is mounted to a rangedb directory on the Storage Node using that assigned file system UUID. The file system UUID and the rangedb directory are listed in the /etc/fstab file. The device name, rangedb directory, and the size of the mounted volume are displayed in the Grid Manager.

In the following example, device /dev/sdc has a volume size of 4 TB, is mounted to /var/local/rangedb/0, using the device name /dev/disk/by-uuid/822b0547-3b2b-472e-ad5e-e1cf1809faba in the /etc/fstab file:



Steps

1. Complete the following steps to record the failed storage volumes and their device names:
 - a. Select **SUPPORT > Tools > Grid topology**.
 - b. Select **site > failed Storage Node > LDR > Storage > Overview > Main**, and look for object stores with alarms.

Object Stores

ID	Total	Available	Stored Data	Stored (%)	Health
0000	96.6 GB	96.6 GB	823 KB	0.001 %	Error
0001	107 GB	107 GB	0 B	0 %	No Errors
0002	107 GB	107 GB	0 B	0 %	No Errors

- c. Select **site > failed Storage Node > SSM > Resources > Overview > Main**. Determine the mount point and volume size of each failed storage volume identified in the previous step.

Object stores are numbered in hex notation. For example, 0000 is the first volume and 000F is the sixteenth volume. In the example, the object store with an ID of 0000 corresponds to /var/local/rangedb/0 with device name sdc and a size of 107 GB.

Volumes

Mount Point	Device	Status	Size	Space Available	Total Entries	Entries Available	Write Cache
/	croot	Online	10.4 GB	4.17 GB	655,360	554,806	Unknown
/var/local	cvloc	Online	96.6 GB	96.1 GB	94,369,792	94,369,423	Unknown
/var/local/rangedb/0	sdc	Online	107 GB	107 GB	104,857,600	104,856,202	Enabled
/var/local/rangedb/1	sdd	Online	107 GB	107 GB	104,857,600	104,856,536	Enabled
/var/local/rangedb/2	sde	Online	107 GB	107 GB	104,857,600	104,856,536	Enabled

2. Log in to the failed Storage Node:

- Enter the following command: `ssh admin@grid_node_IP`
- Enter the password listed in the `Passwords.txt` file.
- Enter the following command to switch to root: `su -`
- Enter the password listed in the `Passwords.txt` file.

When you are logged in as root, the prompt changes from `$` to `#`.

3. Run the following script to unmount a failed storage volume:

```
sn-unmount-volume object_store_ID
```

The `object_store_ID` is the ID of the failed storage volume. For example, specify `0` in the command for an object store with ID `0000`.

4. If prompted, press `y` to stop the Cassandra service depending on storage volume 0.



If the Cassandra service is already stopped, you aren't prompted. The Cassandra service is stopped only for volume 0.

```
root@Storage-180:~/var/local/tmp/storage~ # sn-unmount-volume 0
Services depending on storage volume 0 (cassandra) aren't down.
Services depending on storage volume 0 must be stopped before running
this script.
Stop services that require storage volume 0 [y/N]? y
Shutting down services that require storage volume 0.
Services requiring storage volume 0 stopped.
Unmounting /var/local/rangedb/0
/var/local/rangedb/0 is unmounted.
```

In a few seconds, the volume is unmounted. Messages appear indicating each step of the process. The final message indicates that the volume is unmounted.

5. If the unmount fails because the volume is busy, you can force an unmount using the `--use-umountof` option:



Forcing an unmount using the `--use-umountof` option might cause processes or services using the volume to behave unexpectedly or crash.

```
root@Storage-180:~ # sn-unmount-volume --use-umountof
/var/local/rangedb/2
Unmounting /var/local/rangedb/2 using umountof
/var/local/rangedb/2 is unmounted.
Informing LDR service of changes to storage volumes
```

Recover failed storage volumes and rebuild Cassandra database

You must run a script that reformats and remounts storage on failed storage volumes, and rebuilds the Cassandra database on the Storage Node if the system determines that it is necessary.

Before you begin

- You have the `Passwords.txt` file.
- The system drives on the server are intact.
- The cause of the failure has been identified and, if necessary, replacement storage hardware has already been acquired.
- The total size of the replacement storage is the same as the original.
- You have checked that a Storage Node decommissioning is not in progress, or you have paused the node decommission procedure. (In the Grid Manager, select **MAINTENANCE > Tasks > Decommission**.)
- You have checked that an expansion is not in progress. (In the Grid Manager, select **MAINTENANCE > Tasks > Expansion**.)
- You have [reviewed the warnings about storage volume recovery](#).

Steps

1. As needed, replace failed physical or virtual storage associated with the failed storage volumes that you identified and unmounted earlier.

Don't remount the volumes in this step. The storage is remounted and added to `/etc/fstab` in a later step.

2. In the Grid Manager, go to **NODES > appliance Storage Node > Hardware**. In the StorageGRID Appliance section of the page, verify that the Storage RAID mode is healthy.
3. Log in to the failed Storage Node:
 - a. Enter the following command: `ssh admin@grid_node_IP`
 - b. Enter the password listed in the `Passwords.txt` file.
 - c. Enter the following command to switch to root: `su -`
 - d. Enter the password listed in the `Passwords.txt` file.

When you are logged in as root, the prompt changes from `$` to `#`.

4. Use a text editor (vi or vim) to delete failed volumes from the `/etc/fstab` file and then save the file.



Commenting out a failed volume in the `/etc/fstab` file is insufficient. The volume must be deleted from `fstab` as the recovery process verifies that all lines in the `fstab` file match the mounted file systems.

5. Reformat any failed storage volumes and rebuild the Cassandra database if it is necessary. Enter:

```
reformat_storage_block_devices.rb
```

- When storage volume 0 is unmounted, prompts and messages will indicate that the Cassandra service is being stopped.
- You will be prompted to rebuild the Cassandra database if it is necessary.
 - Review the warnings. If none of them apply, rebuild the Cassandra database. Enter: **y**
 - If more than one Storage Node is offline or if another Storage Node has been rebuilt in the last 15 days. Enter: **n**

The script will exit without rebuilding Cassandra. Contact technical support.

- For each `rangedb` drive on the Storage Node, when you are asked: `Reformat the rangedb drive <name> (device <major number>:<minor number>) ? [y/n] ?`, enter one of the following responses:
 - y** to reformat a drive that had errors. This reformats the storage volume and adds the reformatted storage volume to the `/etc/fstab` file.
 - n** if the drive contains no errors, and you don't want to reformat it.



Selecting **n** exits the script. Either mount the drive (if you think the data on the drive should be retained and the drive was unmounted in error) or remove the drive. Then, run the `reformat_storage_block_devices.rb` command again.



Some StorageGRID recovery procedures use Reaper to handle Cassandra repairs. Repairs occur automatically as soon as the related or required services have started. You might notice script output that mentions "reaper" or "Cassandra repair." If you see an error message indicating the repair has failed, run the command indicated in the error message.

In the following example output, the drive `/dev/sdf` must be reformatted, and Cassandra did not need to be rebuilt:

```
root@DC1-S1:~ # reformat_storage_block_devices.rb
Formatting devices that are not in use...
Skipping in use device /dev/sdc
Skipping in use device /dev/sdd
Skipping in use device /dev/sde
Reformat the rangedb drive /dev/sdf (device 8:64)? [Y/n]? y
Successfully formatted /dev/sdf with UUID b951bfcb-4804-41ad-b490-
805dfd8df16c
All devices processed
Running: /usr/local/ldr/setup_rangedb.sh 12368435
Cassandra does not need rebuilding.
Starting services.
Informing storage services of new volume

Reformatting done. Now do manual steps to
restore copies of data.
```

After the storage volumes are reformatted and remounted and necessary Cassandra operations are complete, you can [restore object data using Grid Manager](#).

Restore object data to storage volume where system drive is intact

After recovering a storage volume on a Storage Node where the system drive is intact, you can restore the replicated or erasure-coded object data that was lost when the storage volume failed.

Which procedure should I use?

Whenever possible, restore object data using the **Volume restoration** page in the Grid Manager.

- If the volumes are listed at **MAINTENANCE > Volume restoration > Nodes to restore**, restore object data using the [Volume restoration page in the Grid Manager](#).
- If the volumes aren't listed at **MAINTENANCE > Volume restoration > Nodes to restore**, follow the steps below for using the `repair-data` script to restore object data.

If the recovered Storage Node contains fewer volumes than the node it is replacing, you must use the `repair-data` script.



The `repair-data` script is deprecated and will be removed in a future release. When possible, use the [Volume restoration procedure in the Grid Manager](#).

Use the `repair-data` script to restore object data

Before you begin

- You have confirmed that the recovered Storage Node has a Connection State of **Connected**  on the **NODES > Overview** tab in the Grid Manager.

About this task

Object data can be restored from other Storage Nodes, an Archive Node, or a Cloud Storage Pool, assuming that the grid's ILM rules were configured such that object copies are available.

Note the following:

- If an ILM rule was configured to store only one replicated copy and that copy existed on a storage volume that failed, you will not be able to recover the object.
- If the only remaining copy of an object is in a Cloud Storage Pool, StorageGRID must issue multiple requests to the Cloud Storage Pool endpoint to restore object data. Before performing this procedure, contact technical support for help in estimating the recovery time frame and the associated costs.
- If the only remaining copy of an object is on an Archive Node, object data is retrieved from the Archive Node. Restoring object data to a Storage Node from an Archive Node takes longer than restoring copies from other Storage Nodes because of the latency associated with retrievals from external archival storage systems.

About the `repair-data` script

To restore object data, you run the `repair-data` script. This script begins the process of restoring object data and works with ILM scanning to ensure that ILM rules are met.

Select **Replicated data** or **Erasure-coded (EC) data** below to learn the different options for the `repair-data` script, based on whether you are restoring replicated data or erasure-coded data. If you need to restore both types of data, you must run both sets of commands.



For more information about the `repair-data` script, enter `repair-data --help` from the command line of the primary Admin Node.



The `repair-data` script is deprecated and will be removed in a future release. When possible, use the [Volume restoration procedure in the Grid Manager](#).

Replicated data

Two commands are available for restoring replicated data, based on whether you need to repair the entire node or only certain volumes on the node:

```
repair-data start-replicated-node-repair
```

```
repair-data start-replicated-volume-repair
```

You can track repairs of replicated data with this command:

```
repair-data show-replicated-repair-status
```

Erasure-coded (EC) data

Two commands are available for restoring erasure-coded data, based on whether you need to repair the entire node or only certain volumes on the node:

```
repair-data start-ec-node-repair
```

```
repair-data start-ec-volume-repair
```

You can track repairs of erasure-coded data with this command:

```
repair-data show-ec-repair-status
```



Repairs of erasure-coded data can begin while some Storage Nodes are offline. However, if all erasure-coded data can't be accounted for, the repair can't be completed. Repair will complete after all nodes are available.



The EC repair job temporarily reserves a large amount of storage. Storage alerts might be triggered, but will resolve when the repair is complete. If there is not enough storage for the reservation, the EC repair job will fail. Storage reservations are released when the EC repair job completes, whether the job failed or succeeded.

Find hostname for Storage Node

1. Log in to the primary Admin Node:

- a. Enter the following command: `ssh admin@primary_Admin_Node_IP`
- b. Enter the password listed in the `Passwords.txt` file.
- c. Enter the following command to switch to root: `su -`
- d. Enter the password listed in the `Passwords.txt` file.

When you are logged in as root, the prompt changes from `$` to `#`.

2. Use the `/etc/hosts` file to find the hostname of the Storage Node for the restored storage volumes. To see a list of all nodes in the grid, enter the following: `cat /etc/hosts`.

Repair data if all volumes have failed

If all storage volumes have failed, repair the entire node. Follow the instructions for **replicated data**, **erasure-coded (EC) data**, or both, based on whether you use replicated data, erasure-coded (EC) data, or both.

If only some volumes have failed, go to [Repair data if only some volumes have failed](#).



You can't run repair-data operations for more than one node at the same time. To recover multiple nodes, contact technical support.

Replicated data

If your grid includes replicated data, use the `repair-data start-replicated-node-repair` command with the `--nodes` option, where `--nodes` is the hostname (system name), to repair the entire Storage Node.

This command repairs the replicated data on a Storage Node named SG-DC-SN3:

```
repair-data start-replicated-node-repair --nodes SG-DC-SN3
```



As object data is restored, the **Objects Lost** alert is triggered if the StorageGRID system can't locate replicated object data. Alerts might be triggered on Storage Nodes throughout the system. You should determine the cause of the loss and if recovery is possible. See [Investigate lost objects](#).

Erasure-coded (EC) data

If your grid contains erasure-coded data, use the `repair-data start-ec-node-repair` command with the `--nodes` option, where `--nodes` is the hostname (system name), to repair the entire Storage Node.

This command repairs the erasure-coded data on a Storage Node named SG-DC-SN3:

```
repair-data start-ec-node-repair --nodes SG-DC-SN3
```

The operation returns a unique `repair ID` that identifies this `repair_data` operation. Use this `repair ID` to track the progress and result of the `repair_data` operation. No other feedback is returned as the recovery process completes.



Repairs of erasure-coded data can begin while some Storage Nodes are offline. Repair will complete after all nodes are available.

Repair data if only some volumes have failed

If only some of the volumes have failed, repair the affected volumes. Follow the instructions for **replicated data**, **erasure-coded (EC) data**, or both, based on whether you use replicated data, erasure-coded (EC) data, or both.

If all volumes have failed, go to [Repair data if all volumes have failed](#).

Enter the volume IDs in hexadecimal. For example, 0000 is the first volume and 000F is the sixteenth volume. You can specify one volume, a range of volumes, or multiple volumes that aren't in a sequence.

All the volumes must be on the same Storage Node. If you need to restore volumes for more than one Storage Node, contact technical support.

Replicated data

If your grid contains replicated data, use the `start-replicated-volume-repair` command with the `--nodes` option to identify the node (where `--nodes` is the hostname of the node). Then add either the `--volumes` or `--volume-range` option, as shown in the following examples.

Single volume: This command restores replicated data to volume 0002 on a Storage Node named SG-DC-SN3:

```
repair-data start-replicated-volume-repair --nodes SG-DC-SN3 --volumes 0002
```

Range of volumes: This command restores replicated data to all volumes in the range 0003 to 0009 on a Storage Node named SG-DC-SN3:

```
repair-data start-replicated-volume-repair --nodes SG-DC-SN3 --volume-range 0003,0009
```

Multiple volumes not in a sequence: This command restores replicated data to volumes 0001, 0005, and 0008 on a Storage Node named SG-DC-SN3:

```
repair-data start-replicated-volume-repair --nodes SG-DC-SN3 --volumes 0001,0005,0008
```



As object data is restored, the **Objects Lost** alert is triggered if the StorageGRID system can't locate replicated object data. Alerts might be triggered on Storage Nodes throughout the system. Note the alert description and recommended actions to determine the cause of the loss and if recovery is possible.

Erasure-coded (EC) data

If your grid contains erasure-coded data, use the `start-ec-volume-repair` command with the `--nodes` option to identify the node (where `--nodes` is the hostname of the node). Then add either the `--volumes` or `--volume-range` option, as shown in the following examples.

Single volume: This command restores erasure-coded data to volume 0007 on a Storage Node named SG-DC-SN3:

```
repair-data start-ec-volume-repair --nodes SG-DC-SN3 --volumes 0007
```

Range of volumes: This command restores erasure-coded data to all volumes in the range 0004 to 0006 on a Storage Node named SG-DC-SN3:

```
repair-data start-ec-volume-repair --nodes SG-DC-SN3 --volume-range 0004,0006
```

Multiple volumes not in a sequence: This command restores erasure-coded data to volumes 000A, 000C, and 000E on a Storage Node named SG-DC-SN3:

```
repair-data start-ec-volume-repair --nodes SG-DC-SN3 --volumes 000A,000C,000E
```

The `repair-data` operation returns a unique `repair ID` that identifies this `repair_data` operation. Use this `repair ID` to track the progress and result of the `repair_data` operation. No other feedback is returned as the recovery process completes.



Repairs of erasure-coded data can begin while some Storage Nodes are offline. Repair will complete after all nodes are available.

Monitor repairs

Monitor the status of the repair jobs, based on whether you use **replicated data**, **erasure-coded (EC) data**, or both.

You can also monitor the status of volume restoration jobs in process and view a history of restoration jobs completed in [Grid Manager](#).

Replicated data

- To get an estimated percent completion for the replicated repair, add the `show-replicated-repair-status` option to the `repair-data` command.

```
repair-data show-replicated-repair-status
```

- To determine if repairs are complete:

1. Select **NODES > Storage Node being repaired > ILM**.
2. Review the attributes in the Evaluation section. When repairs are complete, the **Awaiting - All** attribute indicates 0 objects.

- To monitor the repair in more detail:

1. Select **SUPPORT > Tools > Grid topology**.
2. Select **grid > Storage Node being repaired > LDR > Data Store**.
3. Use a combination of the following attributes to determine, as well as possible, if replicated repairs are complete.



Cassandra inconsistencies might be present, and failed repairs aren't tracked.

- **Repairs Attempted (XRPA)**: Use this attribute to track the progress of replicated repairs. This attribute increases each time a Storage Node tries to repair a high-risk object. When this attribute does not increase for a period longer than the current scan period (provided by the **Scan Period — Estimated** attribute), it means that ILM scanning found no high-risk objects that need to be repaired on any nodes.



High-risk objects are objects that are at risk of being completely lost. This does not include objects that don't satisfy their ILM configuration.

- **Scan Period — Estimated (XSCM)**: Use this attribute to estimate when a policy change will be applied to previously ingested objects. If the **Repairs Attempted** attribute does not increase for a period longer than the current scan period, it is probable that replicated repairs are done. Note that the scan period can change. The **Scan Period — Estimated (XSCM)** attribute applies to the entire grid and is the maximum of all node scan periods. You can query the **Scan Period — Estimated** attribute history for the grid to determine an appropriate time frame.

Erasure-coded (EC) data

To monitor the repair of erasure-coded data and retry any requests that might have failed:

1. Determine the status of erasure-coded data repairs:

- Select **SUPPORT > Tools > Metrics** to view the estimated time to completion and the completion percentage for the current job. Then, select **EC Overview** in the Grafana section. Look at the **Grid EC Job Estimated Time to Completion** and **Grid EC Job Percentage Completed** dashboards.
- Use this command to see the status of a specific `repair-data` operation:

```
repair-data show-ec-repair-status --repair-id repair ID
```

- Use this command to list all repairs:

```
repair-data show-ec-repair-status
```

The output lists information, including `repair ID`, for all previously and currently running repairs.

2. If the output shows that the repair operation failed, use the `--repair-id` option to retry the repair.

This command retries a failed node repair, using the repair ID 6949309319275667690:

```
repair-data start-ec-node-repair --repair-id 6949309319275667690
```

This command retries a failed volume repair, using the repair ID 6949309319275667690:

```
repair-data start-ec-volume-repair --repair-id 6949309319275667690
```

Check storage state after recovering storage volumes

After recovering storage volumes, you must verify that the desired state of the Storage Node is set to online and ensure that the state will be online by default whenever the Storage Node server is restarted.

Before you begin

- You are signed in to the Grid Manager using a [supported web browser](#).
- The Storage Node has been recovered, and data recovery is complete.

Steps

1. Select **SUPPORT > Tools > Grid topology**.
2. Check the values of **Recovered Storage Node > LDR > Storage > Storage State — Desired** and **Storage State — Current**.
The value of both attributes should be Online.
3. If the **Storage State — Desired** is set to Read-only, complete the following steps:
 - a. Click the **Configuration** tab.
 - b. From the **Storage State — Desired** drop-down list, select **Online**.
 - c. Click **Apply Changes**.
 - d. Click the **Overview** tab and confirm that the values of **Storage State — Desired** and **Storage State — Current** are updated to Online.

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