informacijski inženjering

Workshop: Administering Oracle 11.2 RAC databaze na Linuxu

Zoran Jovanović - ORACLE ACE
Technical Support Manager

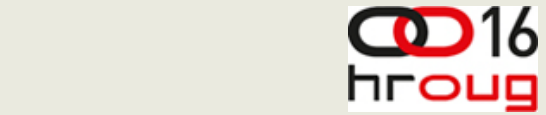
Workshop agenda

- Presentation Implementing Oracle 11g RAC Database on Linux
- Creating single instance rconv database
- Converting single instance rconv database to RAC with rconfig and dbca
- Administering Clusterware
- Administering ASM

Workshop agenda

- For exercises participants will use Oracle 11g R2 RAC configuration on two Vmware virtual machines with Linux operating system
- Exercises will be performed in groups of two participants using separate Oracle 11g R2 RAC configurations
- Before exercises you will get an information about virtual machines, IP adresses and usernames/passwords for your group

informacijski inženjering



Implementing Oracle 11g RAC Database on Linux

Zoran Jovanovic

Technical Support Manager

Prepare RAC implementation plan

Requirements definition

- defining project scope
- defining project team
- defining service-level requirements
- defining project schedule

Prepare RAC implementation plan

Technical architecture design and build

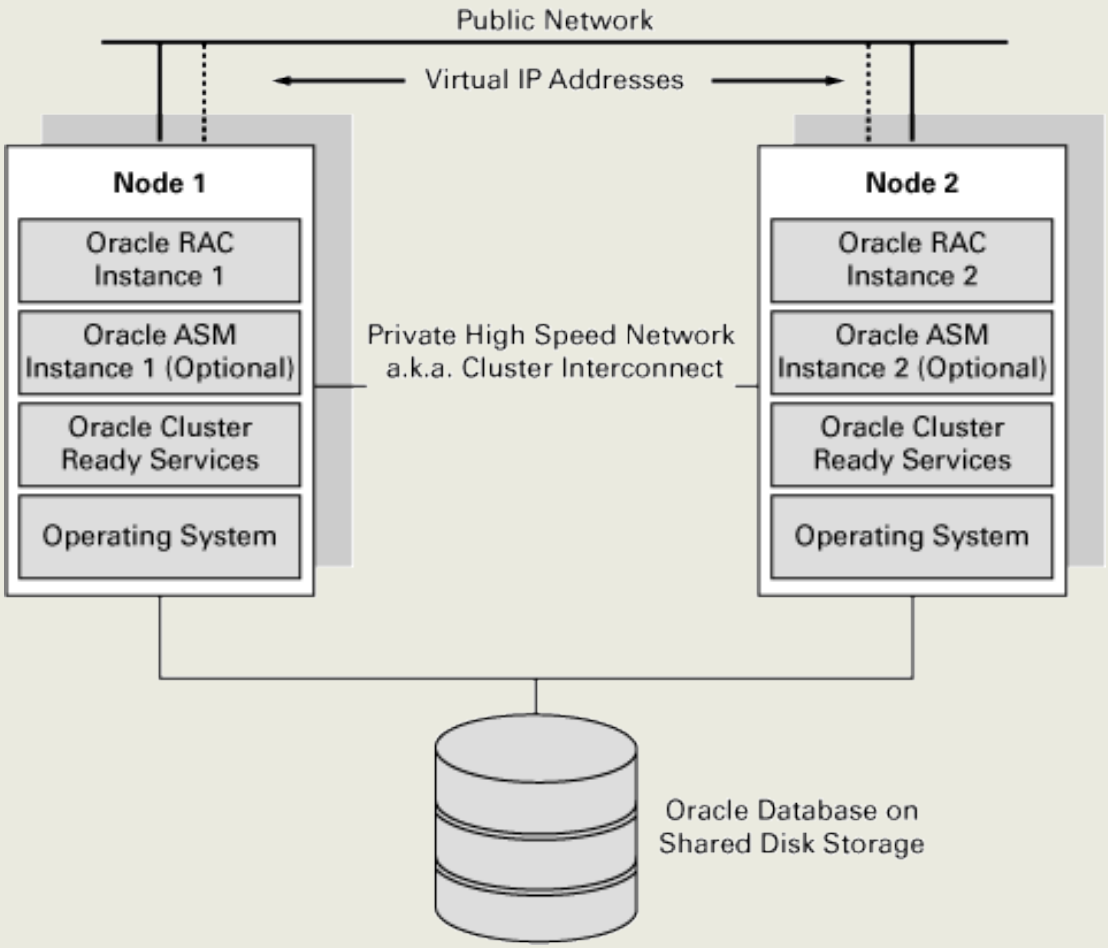
- determining the hardware and software specifications
- implementing the specifications
  - configure network environment
  - configure shared storage (NAS, SAN)
  - configure operating system
  - configure Oracle software
  - operational tasks
    - perform data loads
    - perform index builds
    - setup OS and database backups
    - install and configure performance monitoring utilities

Prepare RAC implementation plan

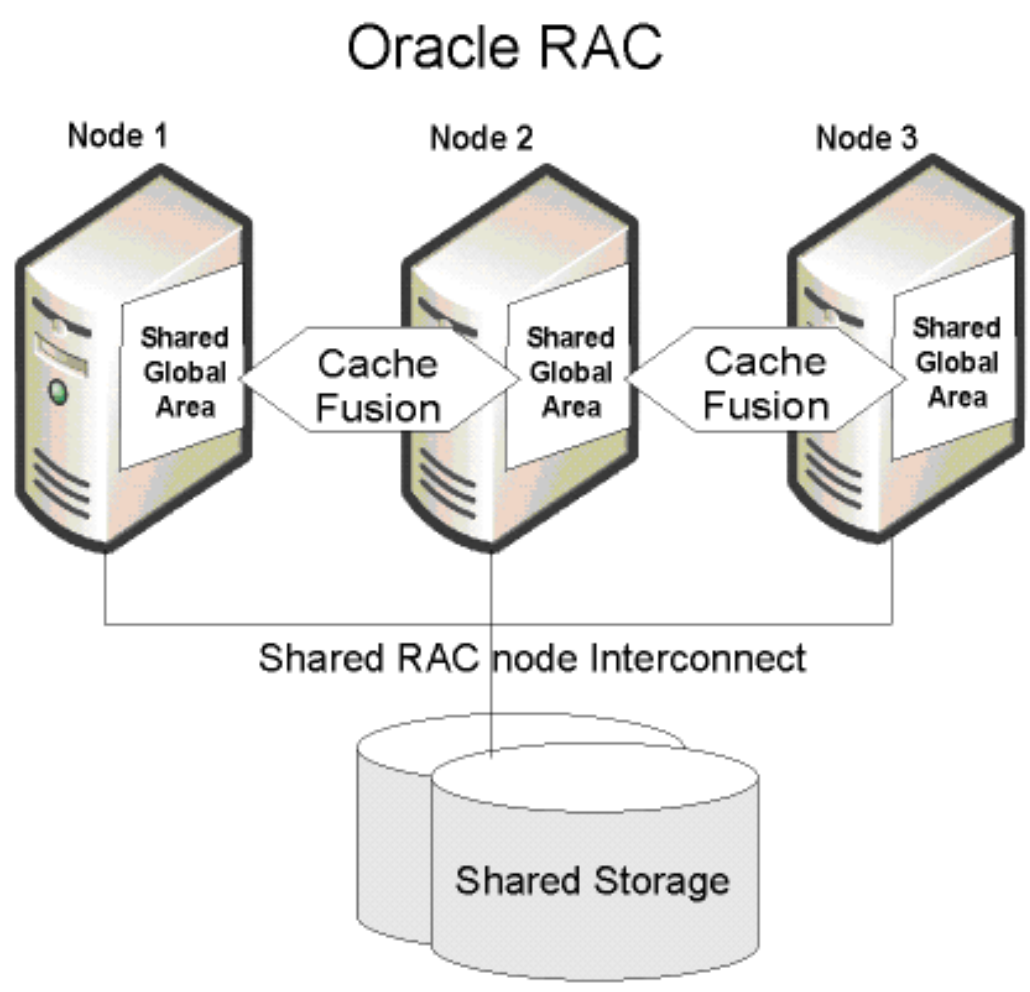
RAC system testing

- proof-of-concept testing
- unit testing
- integration testing
- stress testing

RAC architecture



RAC architecture



Preinstallation Considerations

Study documentation

- Installation documentation for Oracle RAC Database on Linux
- RAC and Oracle Clusterware Starter Kit and Best Practices: Generic [ID 810394.1] and Linux [ID 811306.1]
- Oracle Recommended Patches -- Oracle Database [ID 756671.1]
- Oracle Database 11g R1 Automatic Storage Management Overview and Technical Best Practices
- RACGuides Rac11gR1OnLinux or RACGuides Rac11gR1OnLinux

Preinstallation Considerations

- Eliminate any single points of failure in the architecture
- Review Oracle's Maximimum Availability Architecture recommendations
- Plan capacity requirements for CPU, memory, network and storage based on expected production workload
- Oracle recommends using Oracle Clusterware
- Automatic Storage Management is recommended for database storage
- Check that all the components of the architecture (hardware, software, network, storage) are certified for Oracle 11g RAC database

Configure network environment

- Each node must have at least three NICs for:
  - Public IP
  - Virtual IP
  - Cluster interconnect
- Defaul gateway must be on the same subnet as Virtual IP
- NICs must have the same names on all nodes in the cluster
- Do not use underscore in host or domain names
- Configure NICs for fault tolerance (bonding/link aggregation)
- Configure NICs correctly in terms of speed, duplex ...

Configure network environment

- Use non-routable network addresses for cluster interconnect:
  - Class A: 10.0.0.0 to 10.255.255.255,
  - Class B: 172.16.0.0 to 172.31.255.255,
  - Class C: 192.168.0.0 to 192.168.255.255
- Configure Jumbo Frames for cluster interconnect if possible: 9.000 byte frames are used instead of 1.500 bytes
- Cluster interconnect must be connected to a switch (crossover cable is not supported) with a dedicated VLAN
- NIC names must not contain „.”

Configure shared storage

- Use correct mount options for NFS disks (see Mount Options for Oracle files when used with NAS devices [ID 359515.1])
- Implement multiple access paths to storage array using two or more HBAs or initiators with multi-pathing software
- Stripe and mirror shared disks with 1 MB stripe size (ASM stripe size)
- Configure disk groups with disks of same size and performance characteristics
- Configure disk groups with four or more disks

Configure shared storage

- Create two ASM disk groups on separate physical disks:
  - one for database area and
  - one for flash recovery area
- Place database and redo log files in database area
- It is recommended to utilize Oracle redundancy for the OCR and Voting Disks
- You must create odd number of Voting Disks OCR and Voting disks can be stored on raw, block devices, OCFS or ASM (11gR2 only)

Configure shared storage

- For OCR and Voting disks you must have at least three LUNs each having the following minimal sizes:
  - 280 MB (for 11gR1)
  - 2 GB (for 11gR2)
- By default, Oracle uses the asynchronous I/O (AIO) on Linux
- Use of raw devices is not recommended – they will be removed from future Linux distributions

Configure operating system

- Install certified version of Linux OS
- Install all Linux packages required in Oracle install documentation
- Configure kernel parameters
- Create Linux groups dba, oinstall and oper
- Create Linux user to own Oracle installation (tipically oracle)
- For CRS, ASM, and Oracle ensure one unique User ID with a single name, is in use across the cluster

Configure operating system

- Machine clocks must be synchronized on all nodes to the same NTP source
- Configure the system logger to log messages to one central server
- Hangcheck-timer Module is required on both oracle 10g and 11g RAC on Linux.
- Assuming the default setting of "CSS misscount" is set to either 30 or 60 seconds, the recommended hangcheck-timer settings are: hangcheck_tick=1 hangcheck_margin=10 hangcheck_reboot=1

Configure operating system

- For versions 10.2.0.4 and 11gR1, it is a best practice on all platforms to set the CSS diagwait parameter to 13 (not required in 11gR2)
- Set shell limits for oracle user in /etc/security/limits.conf:

  oracle soft nproc 2047

  oracle hard nproc 16384

  oracle soft nofile 1024

  oracle hard nofile 65536

Configure operating system

- Configure SELinux to disabled or permissive mode in /etc/selinux/conf:
  „SELINUX=disabled” or „SELINUX=permissive”
- Configure ssh equivalence for oracle user on cluster member nodes
- Create three Oracle home directories:
  - Clusterware home
  - ASM home
  - Database home
- Set ORACLE_BASE directory

Configure operating system

- Partition LUNs on shared disks used for: voting disks, OCR and ASM disks with fdisk
- Partitions used for ASM disks must be aligned to 1MB boundary:

```
# fdisk /dev/sdb
Command (m for help): u
Changing display/entry units to sectors
Command (m for help): p
Command (m for help): n
Command action
e extended
p primary partition (1-4)
p
Partition number (1-4): 1
First sector (63-4194303, default 63): 2048 <<<< Start at 1M
Last sector or +size or +sizeM or +sizeK (32768-4194303, default 4194303):
Using default value 4194303
```

Configure operating system

- Install ASMLib (download from OTN)
- Install ASMLib driver that matches Linux kernel version:

oracleasm-2.6.18-128.el5-2.0.5-1.el5.i686.rpm ←- **kernel 2.6.18-128**
oracleasm-support-2.1.3-1.el5.i386.rpm
oracleasmlib-2.0.4-1.el5.i386.rpm

- Configure ASMLib

/etc/init.d/oracleasm configure

- Create ASM disks from shared disk partitions:
- # /etc/init.d/oracleasm createdisk

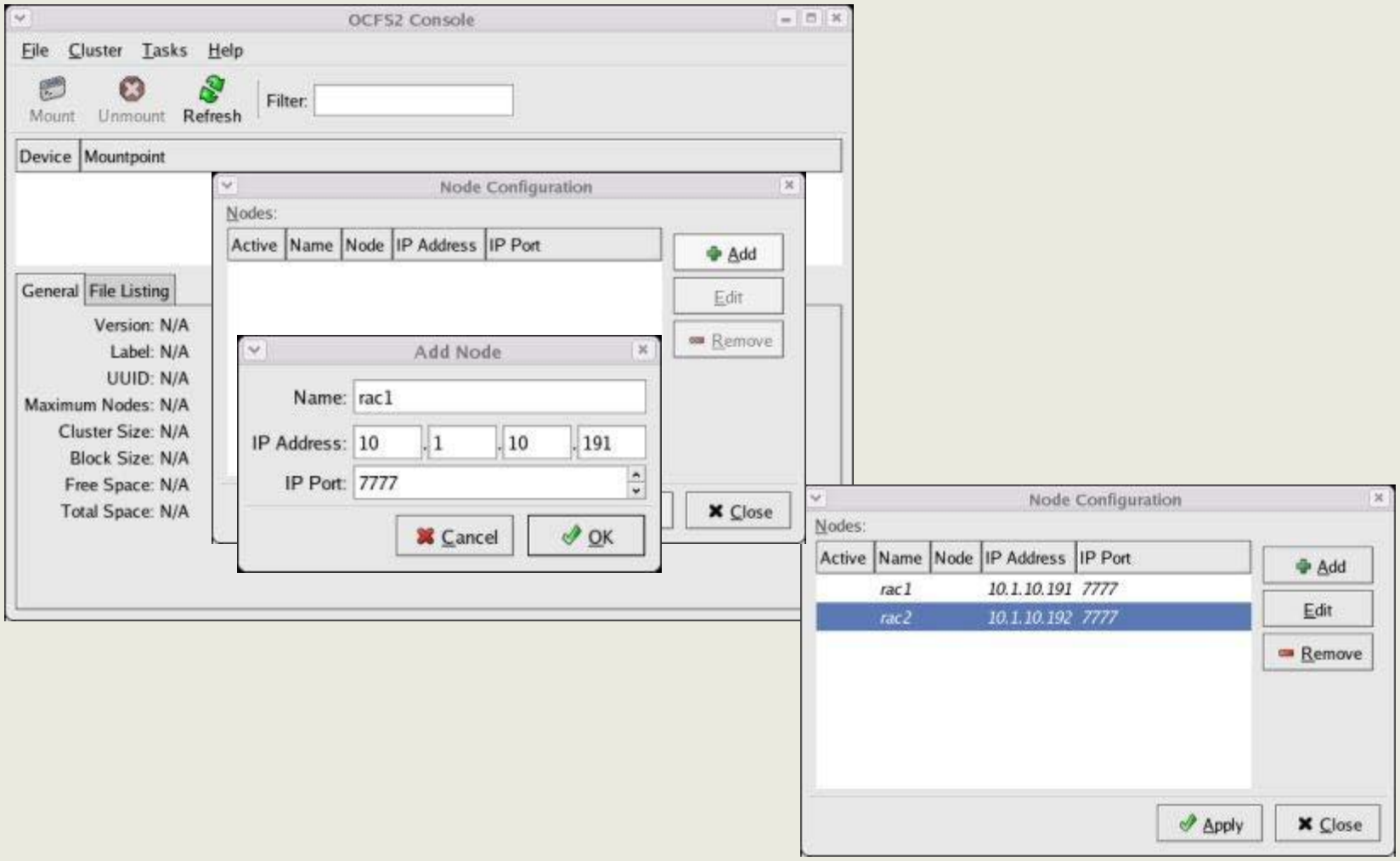
Configure operating system

- Install OCFS for voting disks and OCR (download from OTN)
- Install OCFS driver that matches Linux kernel version:

```
# rpm -Uvh ocfs2-2.6.9-22.EL-1.2.1-1.i686.rpm \
ocfs2console-1.2.1-1.i386.rpm \
ocfs2-tools-1.2.1-1.i386.rpm \
ocfs2-tools-debuginfo-1.2.1-1.i386.rpm
```

- Configure cluster nodes for OCFS with ocfs2console

Configure operating system



Configure operating system

- Configure OCFS driver with:

/etc/init.d/o2cb configure

- Create mount points for OCFS filesystems
- Format disk partitions for OCFS filesystem with ocfs2console
- Mount OSFS formated disk partitions
- Configure entries in /etc/fstab on each cluster node to automatically mount OCFS filesystems

/dev/sdb1 /u02 ocfs2 _netdev,datavolume 0 0

Configure operating system

- Install Cluster Verification Utility to check installation prerequisites

cluvfy stage {-pre-post} [-verbose]
SYNTAX (for Stages):
cluvfy stage -post hwos -n [-s] [-verbose]
cluvfy stage -pre cfs -n -s [-verbose]
cluvfy stage -post cfs -n -f [-verbose]
cluvfy stage -pre crsinst -n [-r { 10gR1 10gR2 }]
[-c] [-q]
[-osdba]
[-orainv] [-verbose]
cluvfy stage -post crsinst -n [-verbose]
cluvfy stage -pre dbinst -n [-r { 10gR1 10gR2 }]
[-osdba] [-verbose]
cluvfy stage -pre dbcfg -n -d [-verbose]

Configure operating system

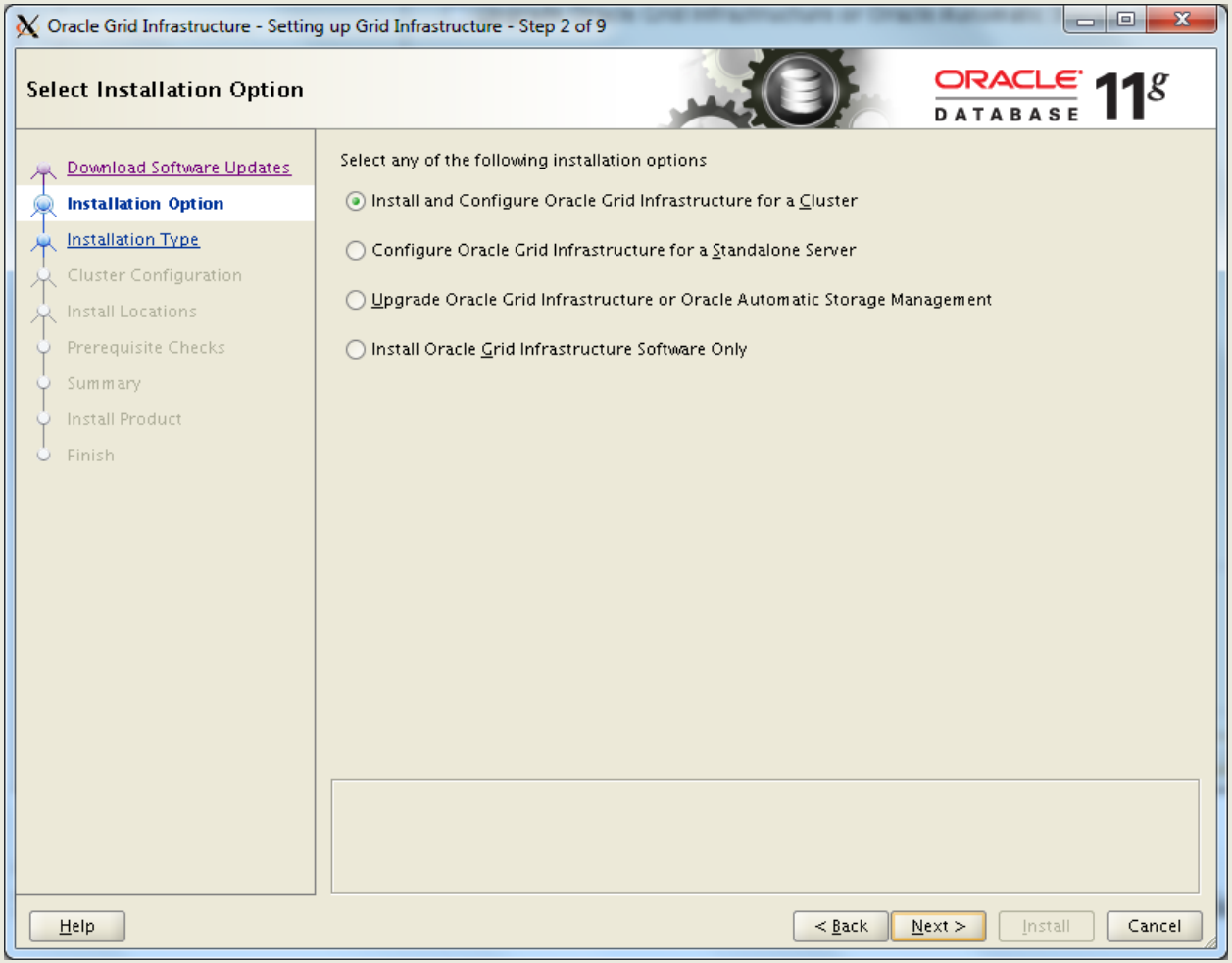
- Configure NICs for public, private and interconnect Ips with ifconfig
- Configure /etc/hosts with hostnames and IP addresses

```
# Do not remove the following line, or various programs
# that require network functionality will fail.
192.168.78.51 rac11gtst1 rac11gtst1.tst.org
192.168.78.61 rac11gtst1-vip rac11gtst1-vip.tst.org
172.16.100.51 rac11gtst1-priv rac11gtst1-priv.tst.org
192.168.78.52 rac11gtst2 rac11gtst2.tst.org
192.168.78.62 rac11gtst2-vip rac11gtst2-vip.tst.org
172.16.100.52 rac11gtst2-priv rac11gtst2-priv.tst.org
192.168.78.53 rac11gr2tst rac11gr2tst.tst.org
::1 localhost6.localdomain6 localhost6
127.0.0.1 localhost.localdomain localhost
```

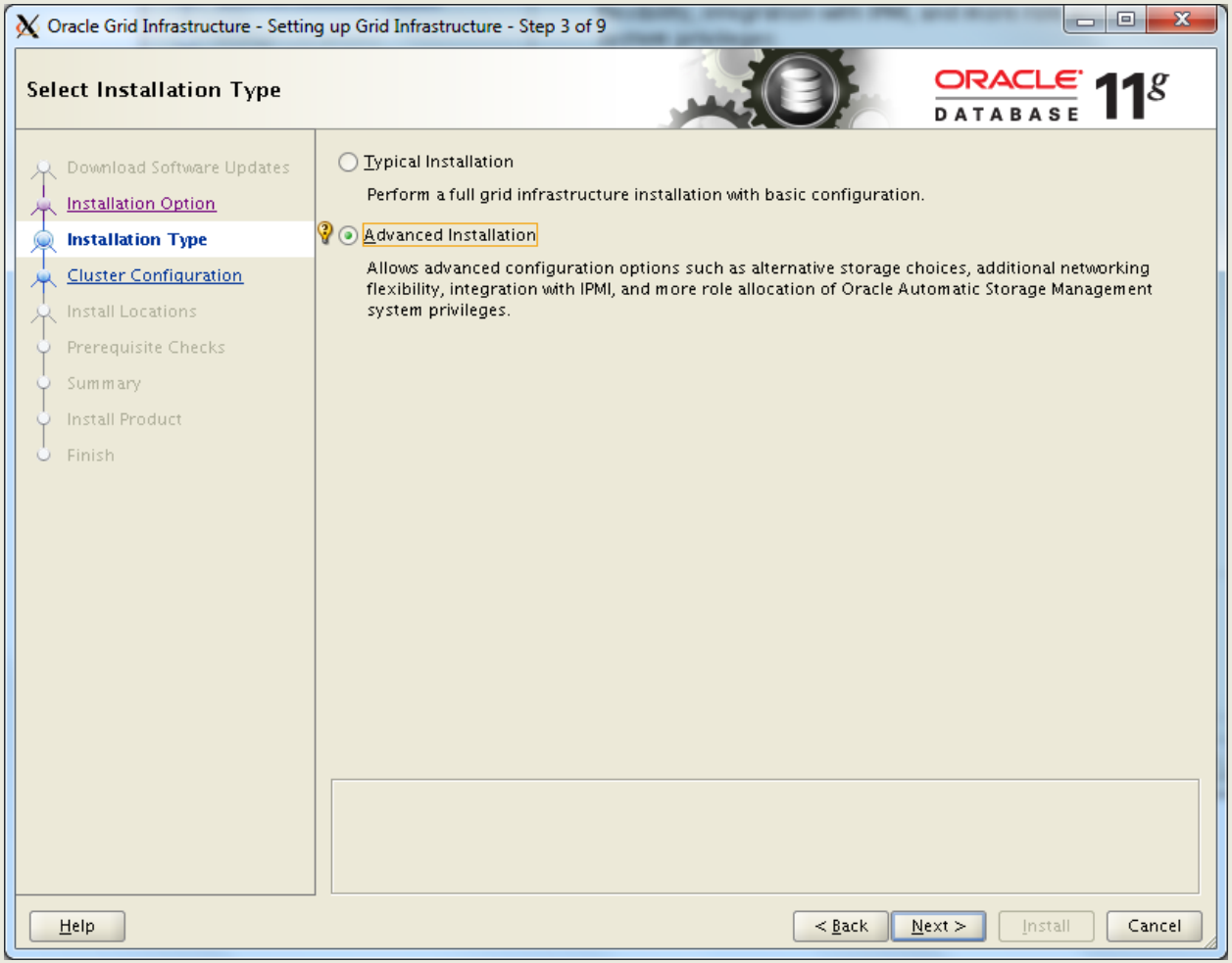
Configure Oracle software

- Installation order:
- Clusterware home
  - Base version
  - Recommended patchset
  - Latest opatch version
  - Recommended patch set update
- ASM home
  - Base version
  - Recommended patchset
  - Latest opatch version
  - Recommended patch set update
- Database home
  - Base version
  - Recommended patchset
  - Latest opatch version
  - Recommended patch set update

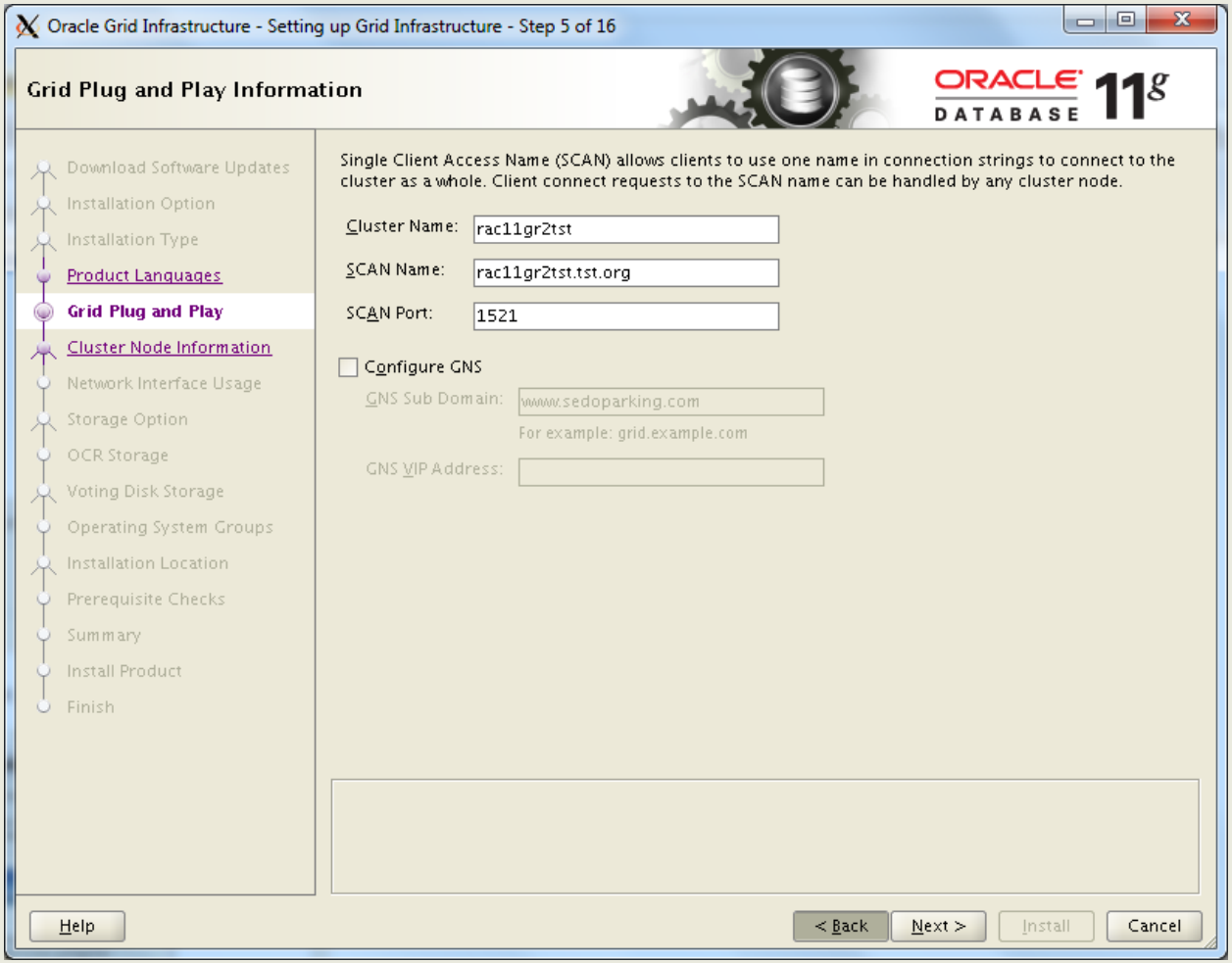
Clusterware install



Clusterware install



Clusterware install



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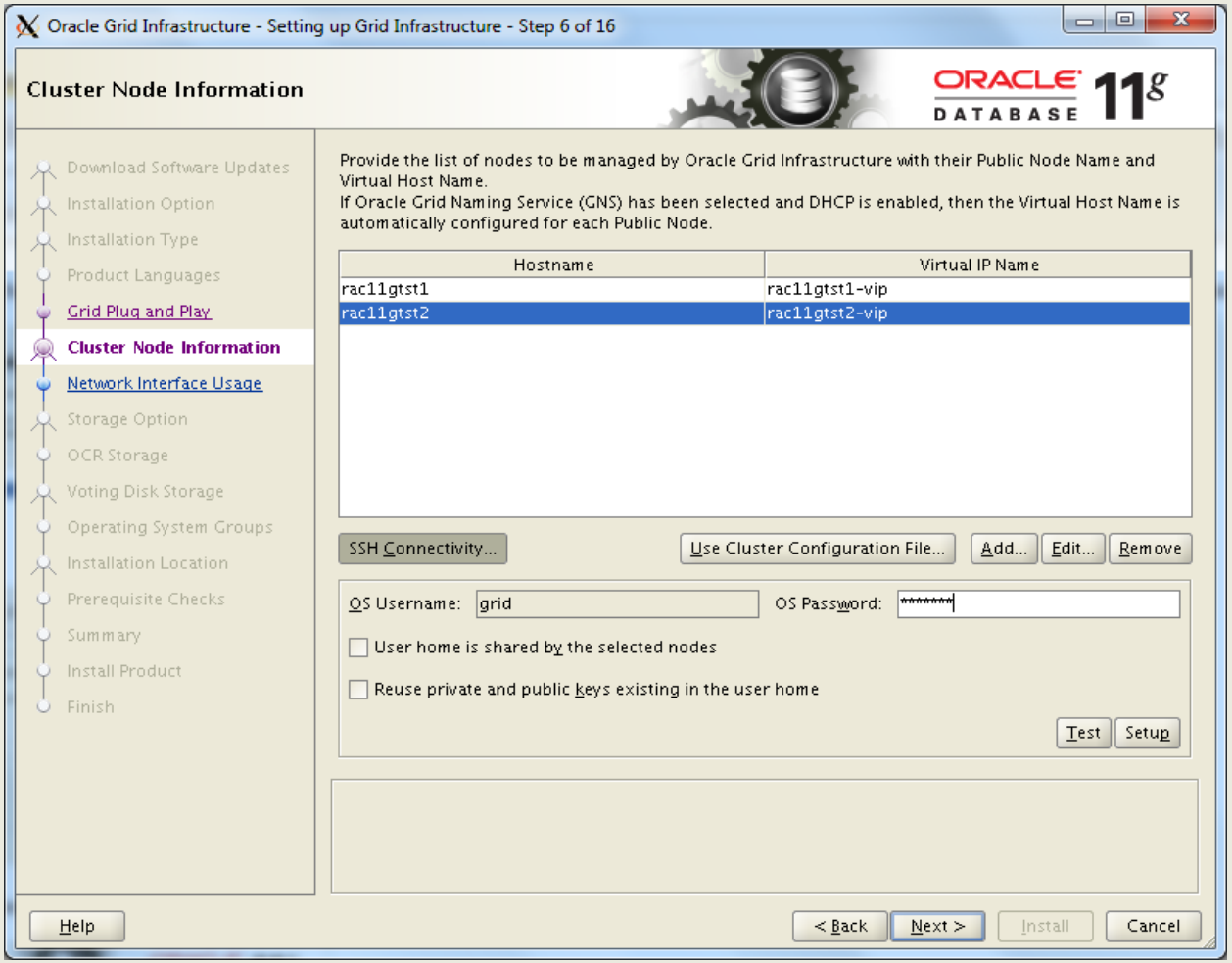
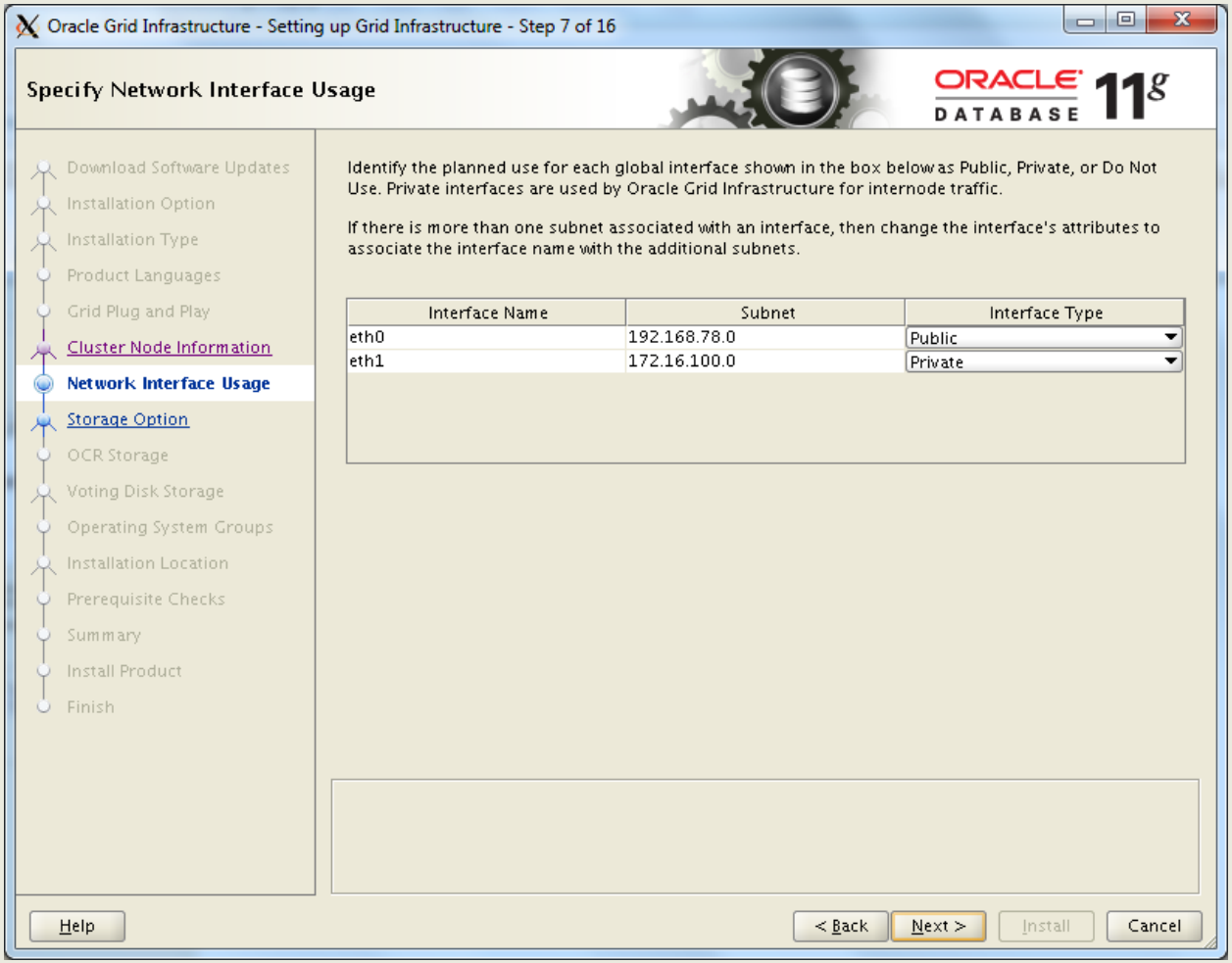


Clusterware install



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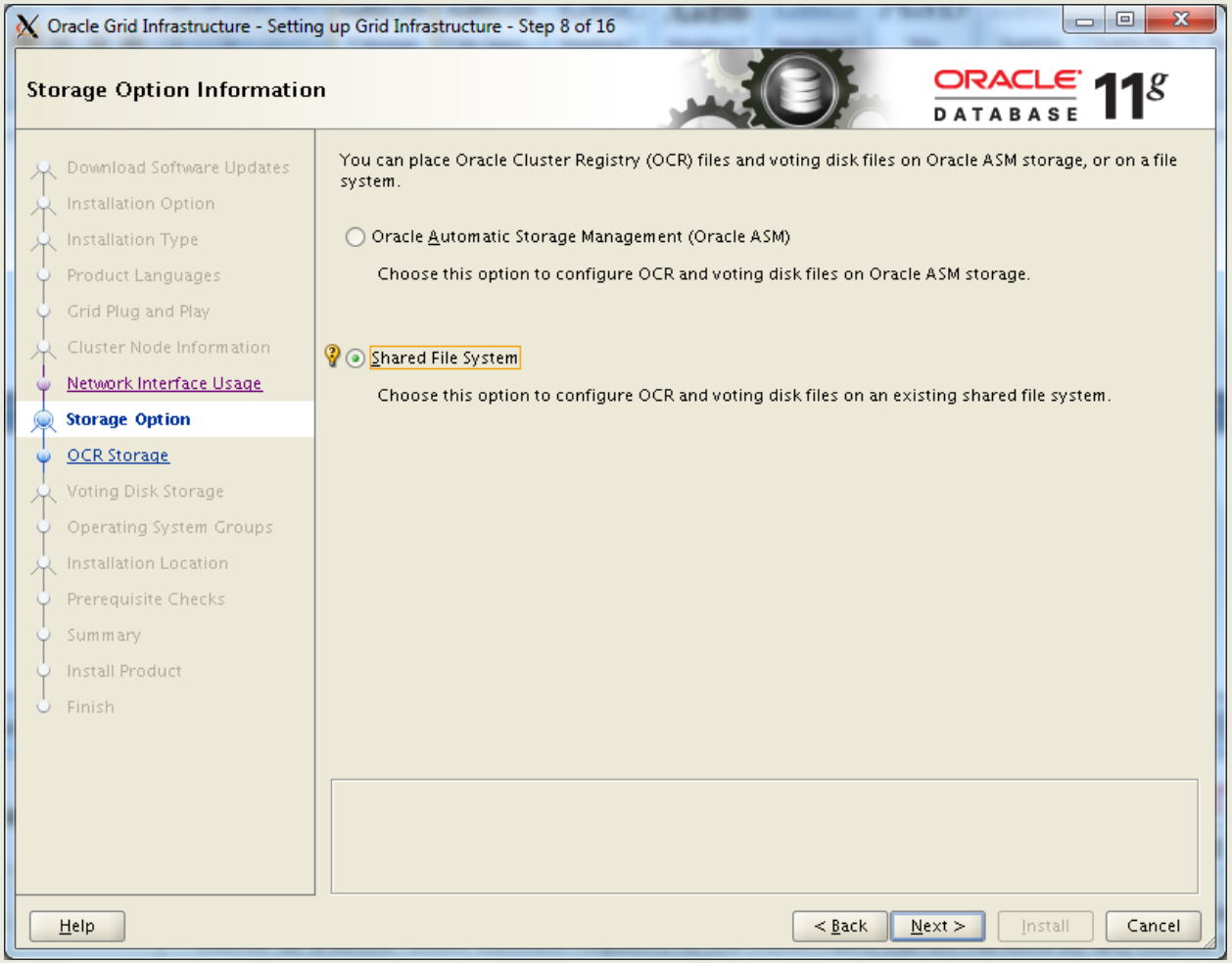

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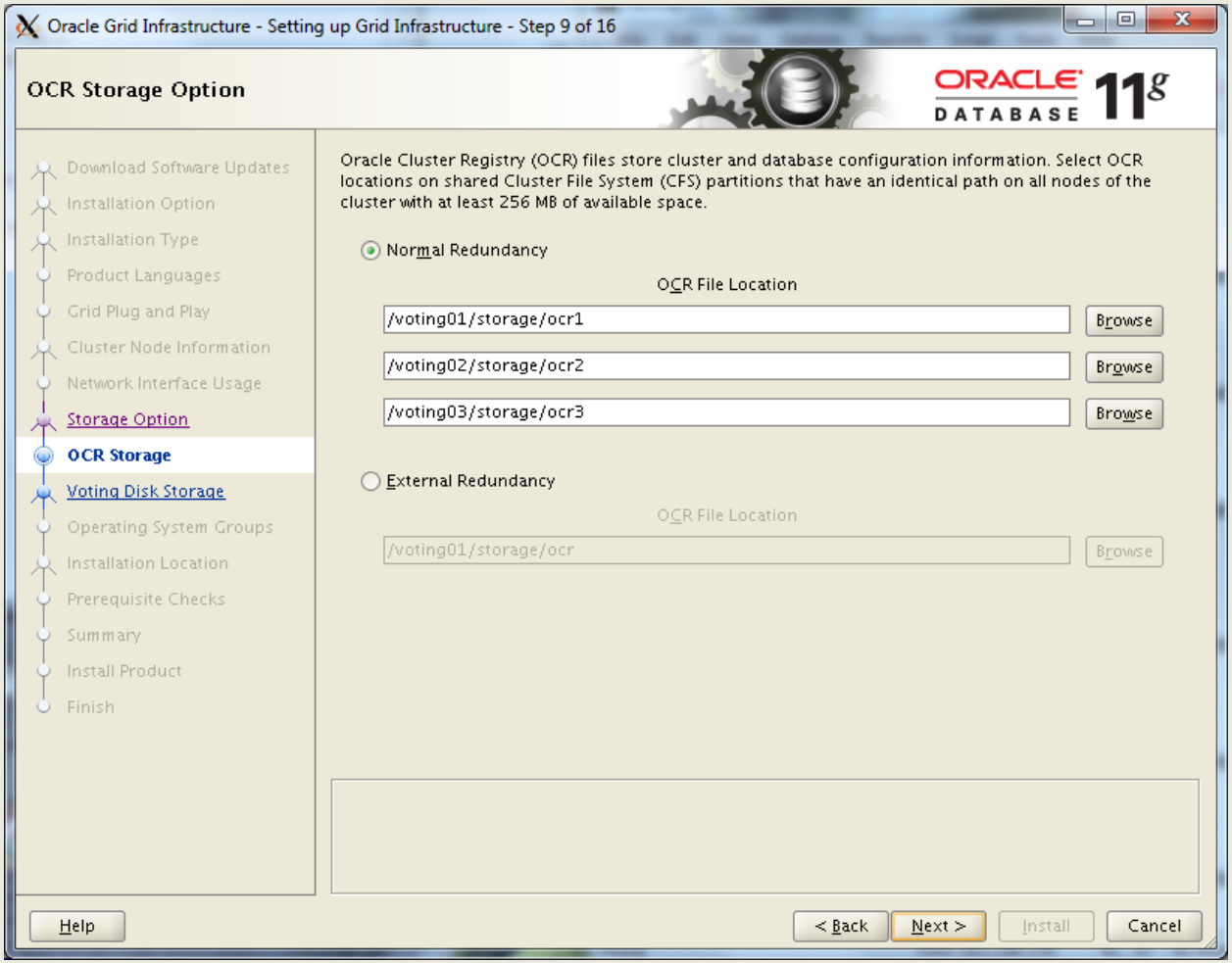

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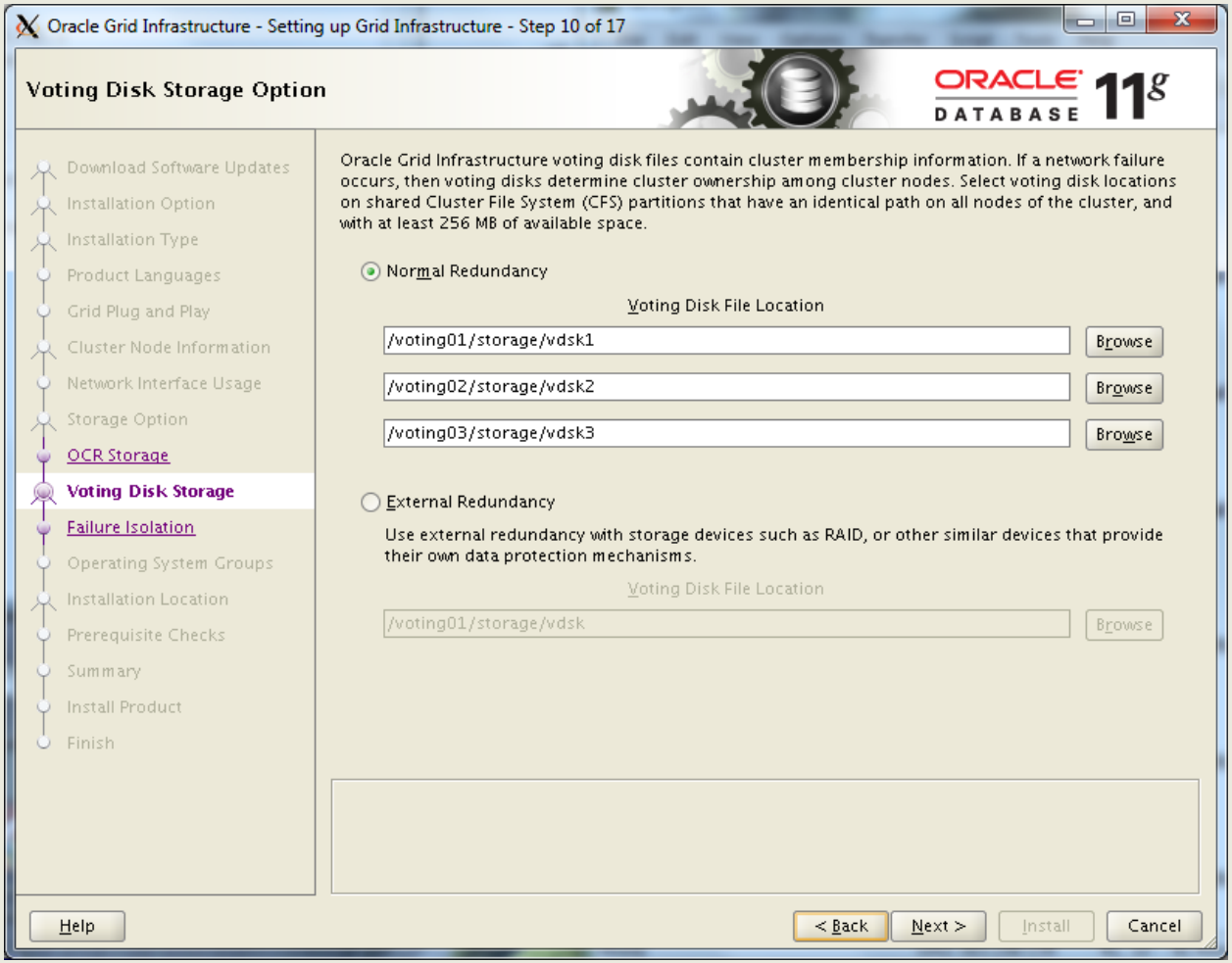

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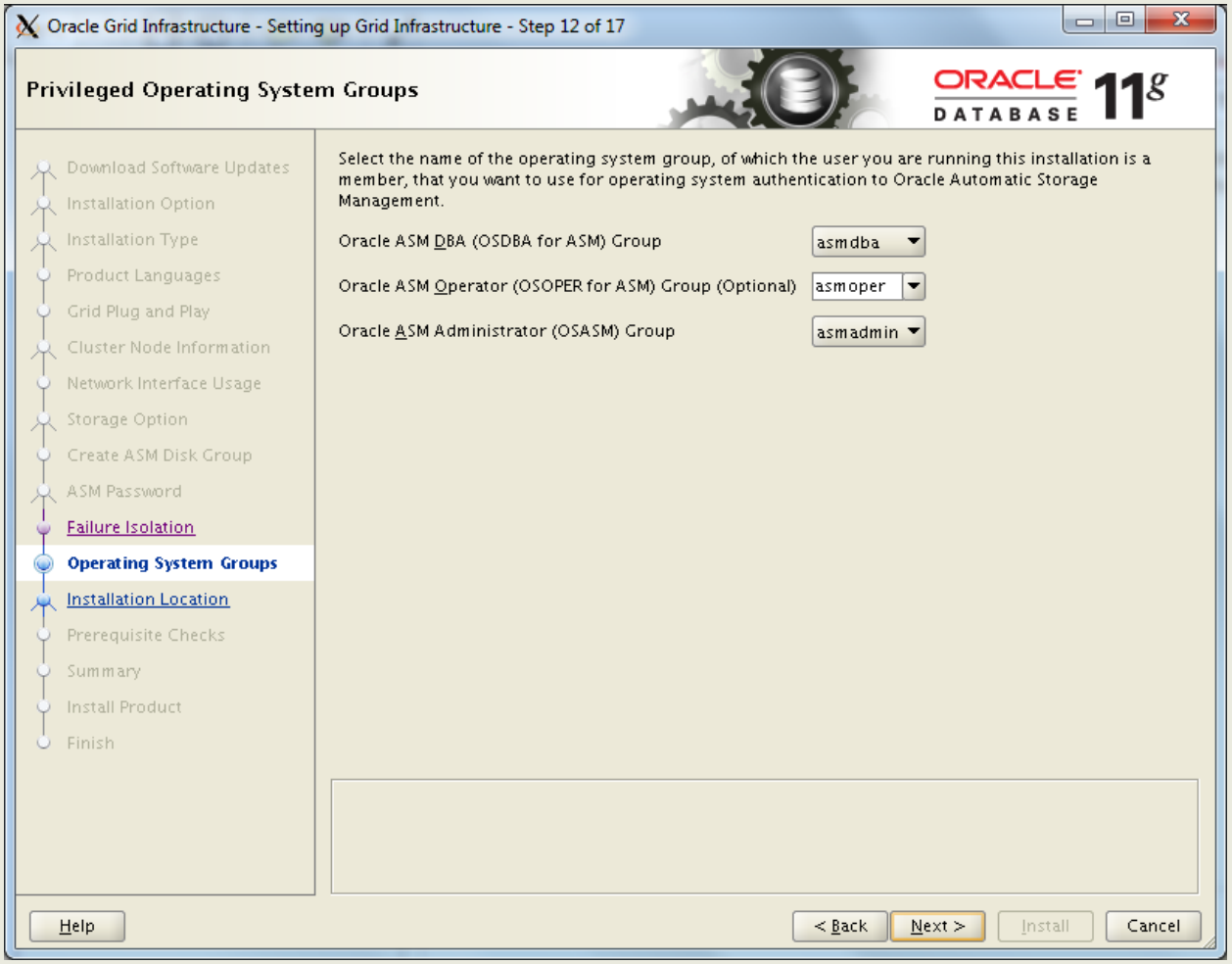

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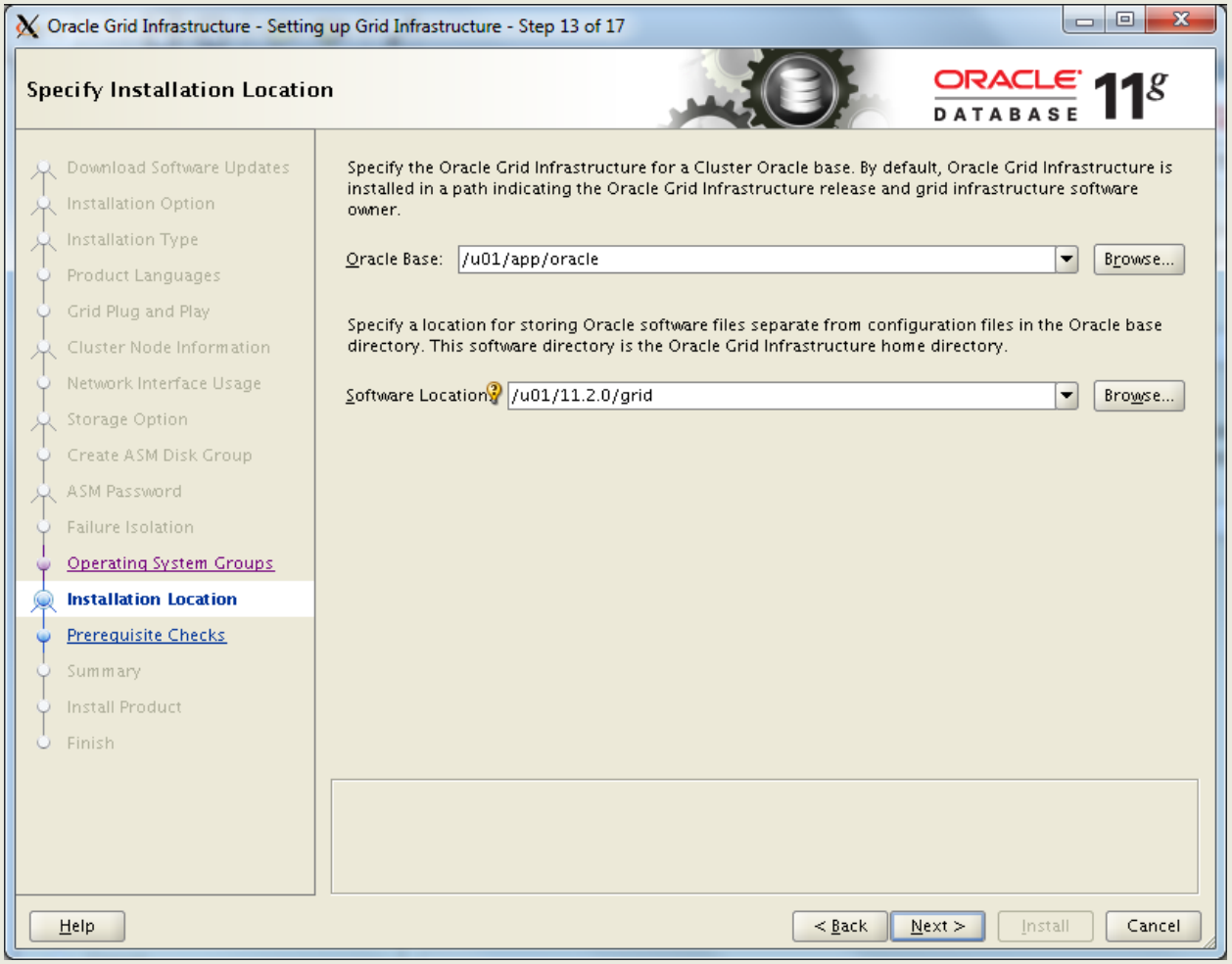

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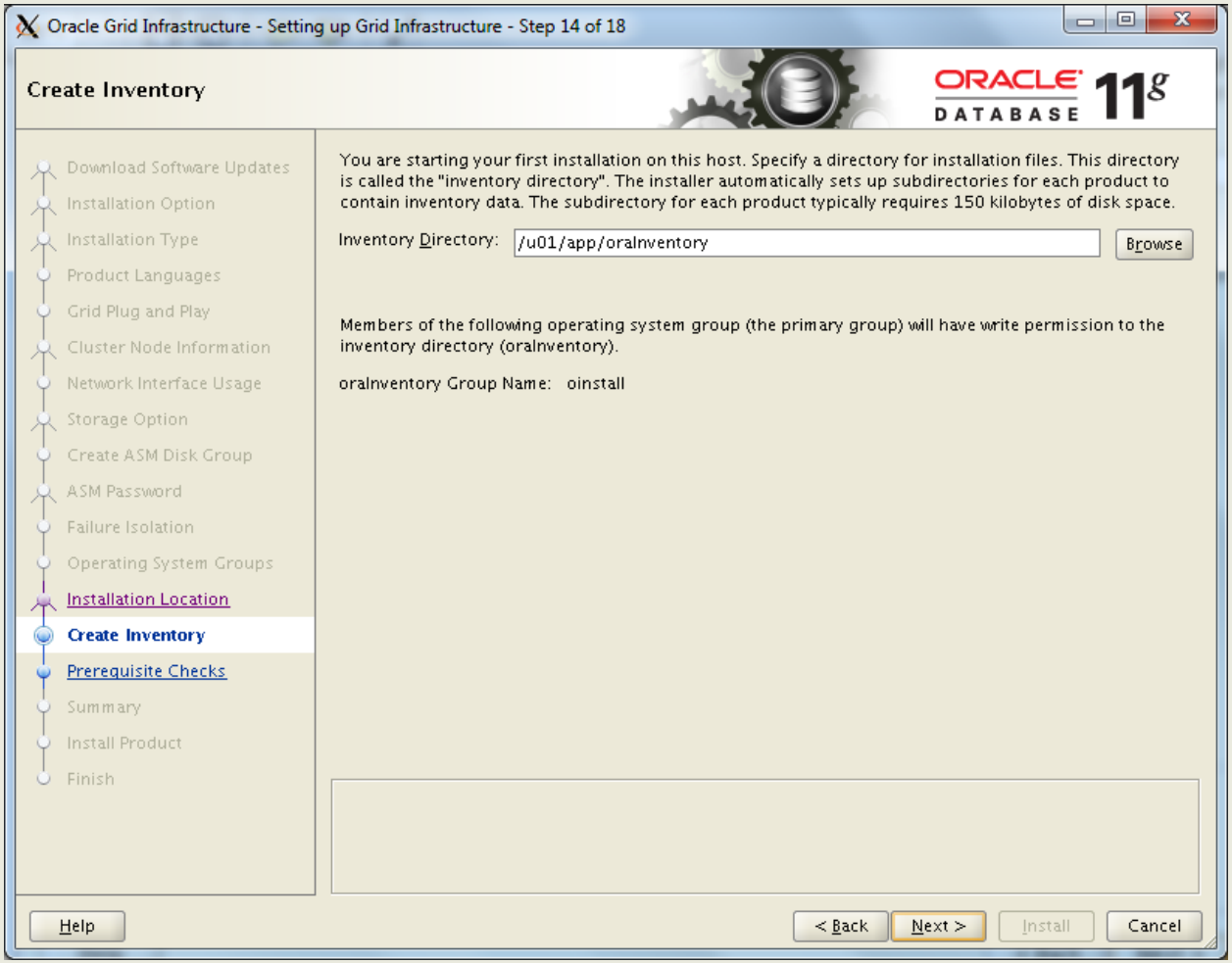

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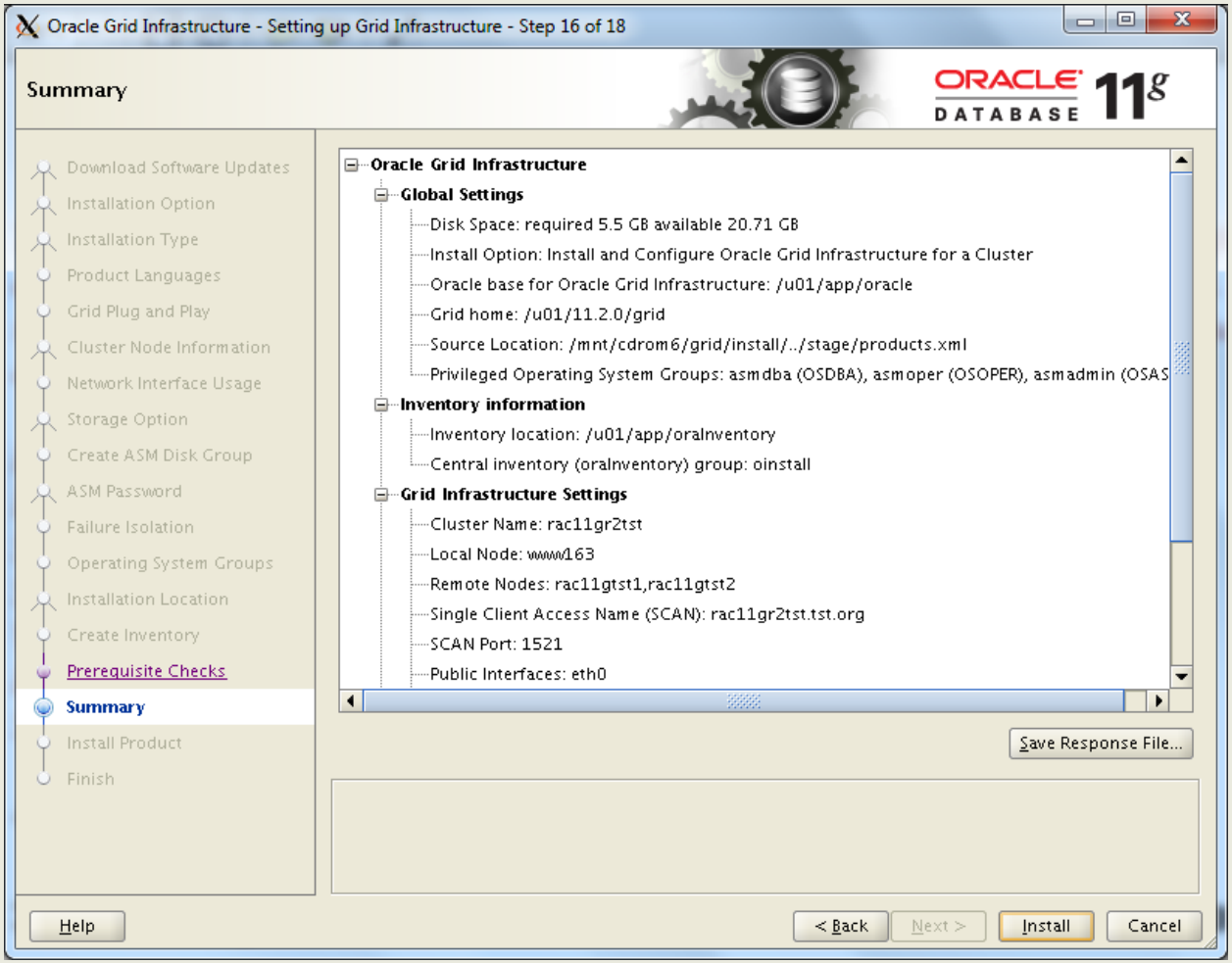

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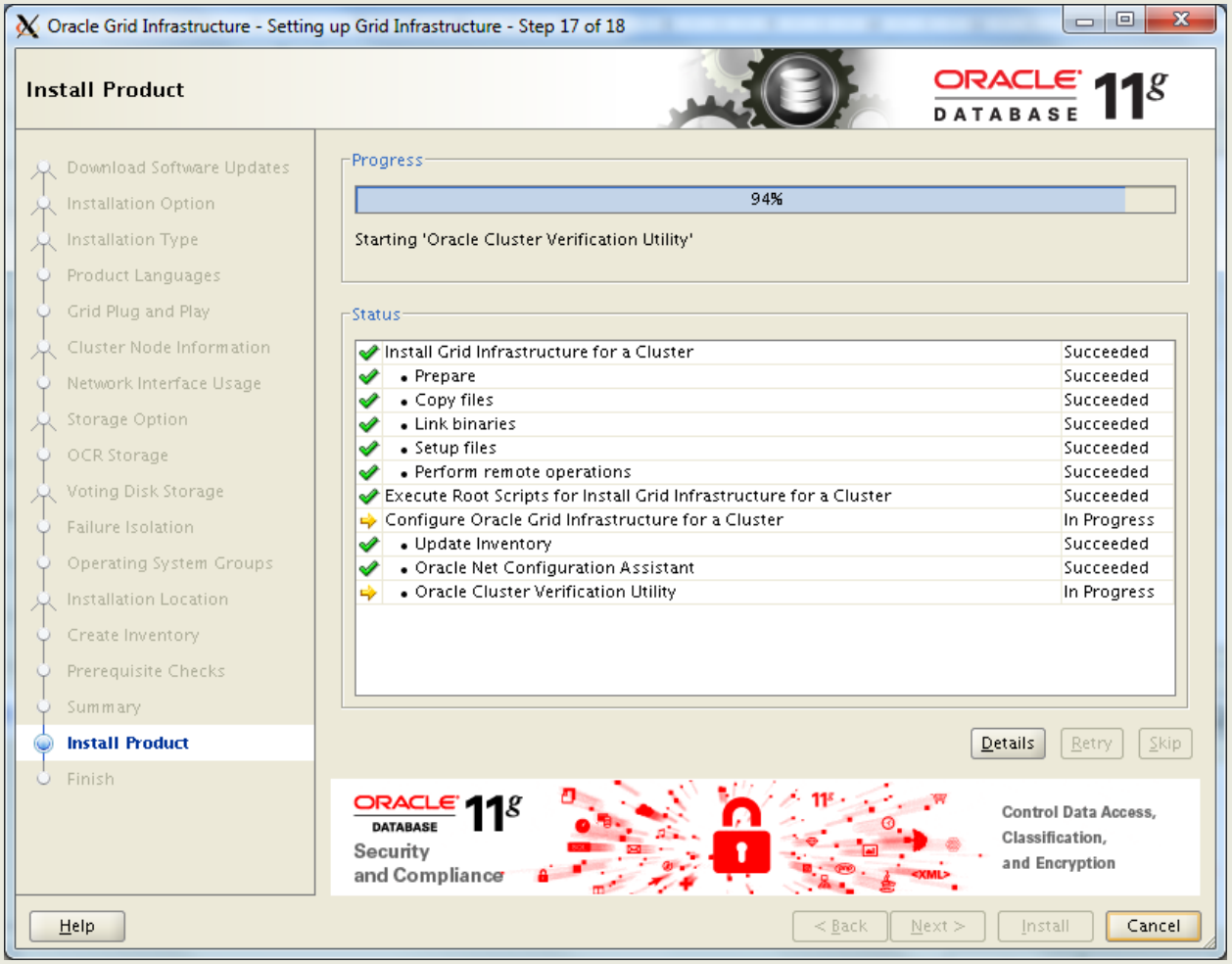
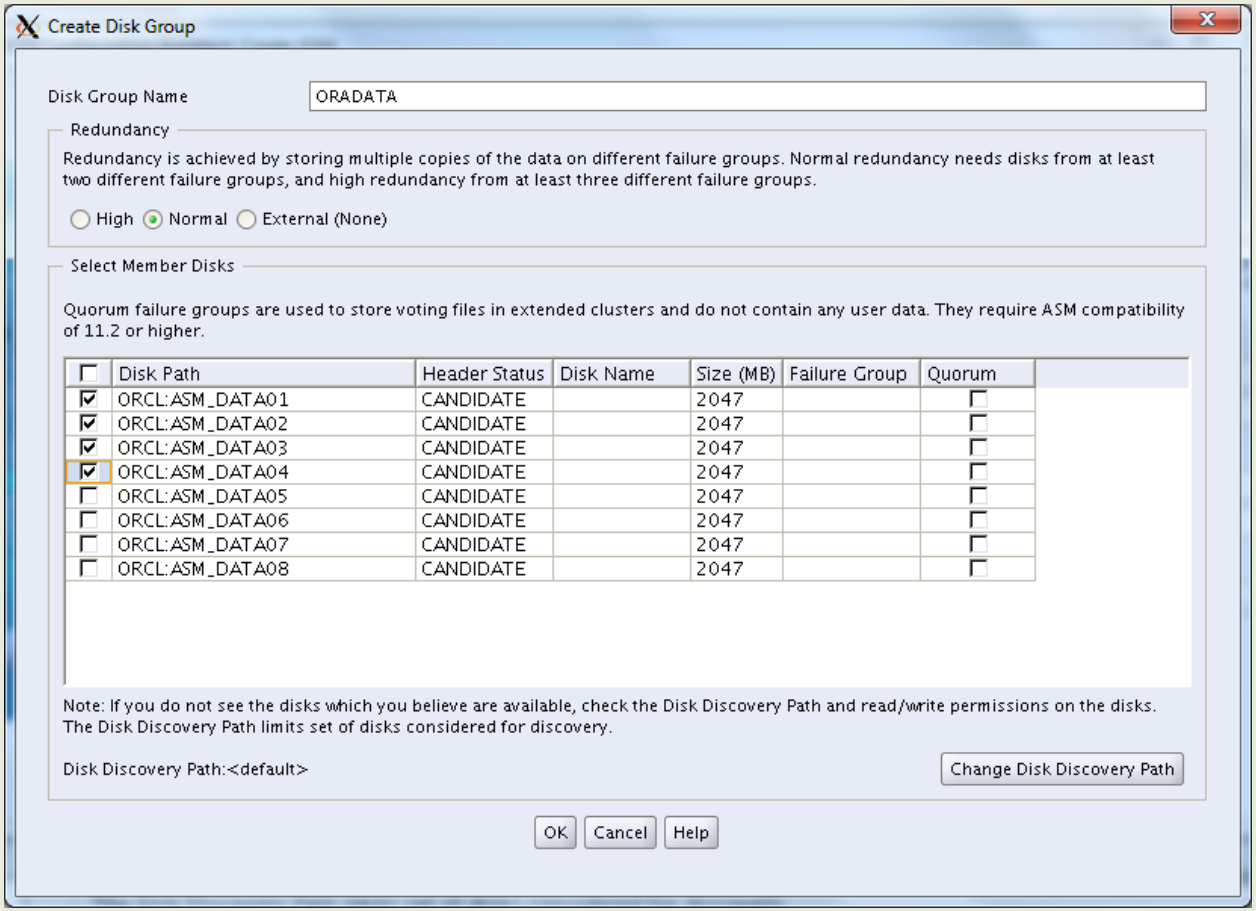


Create and configure ASM instance



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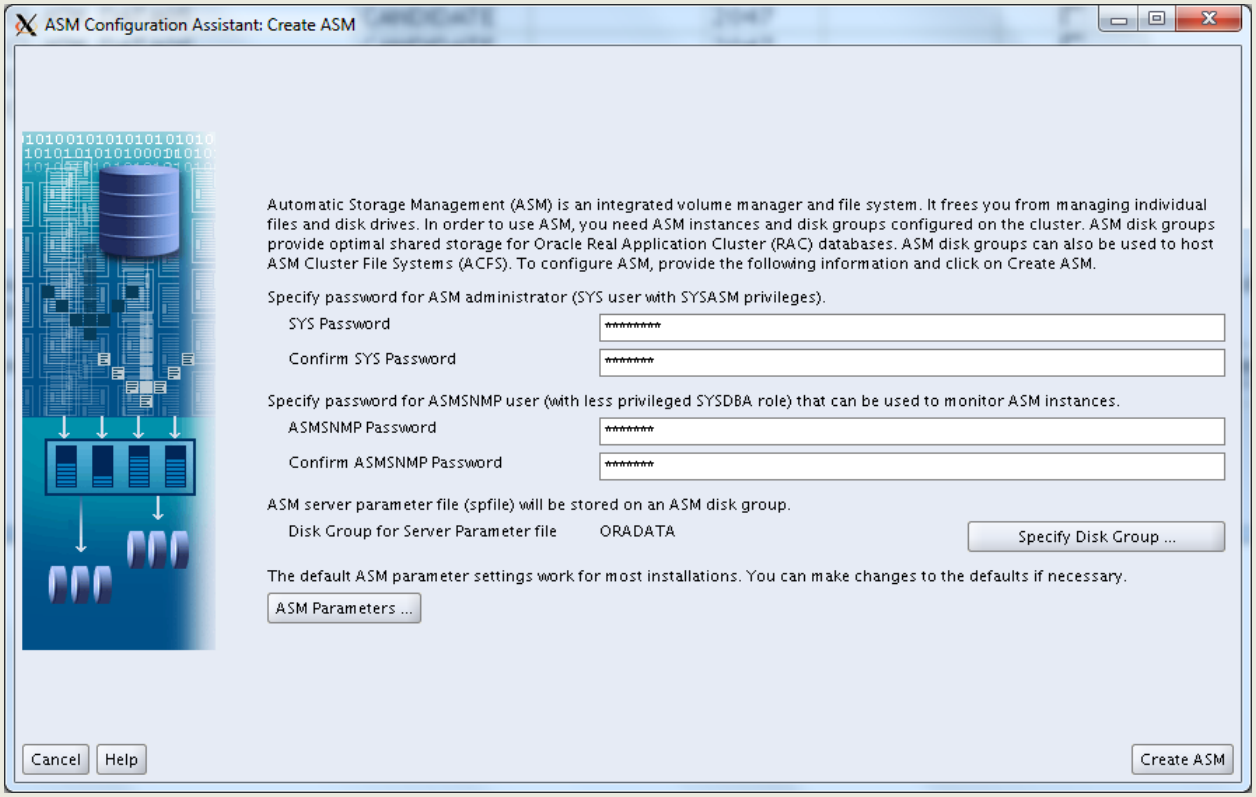

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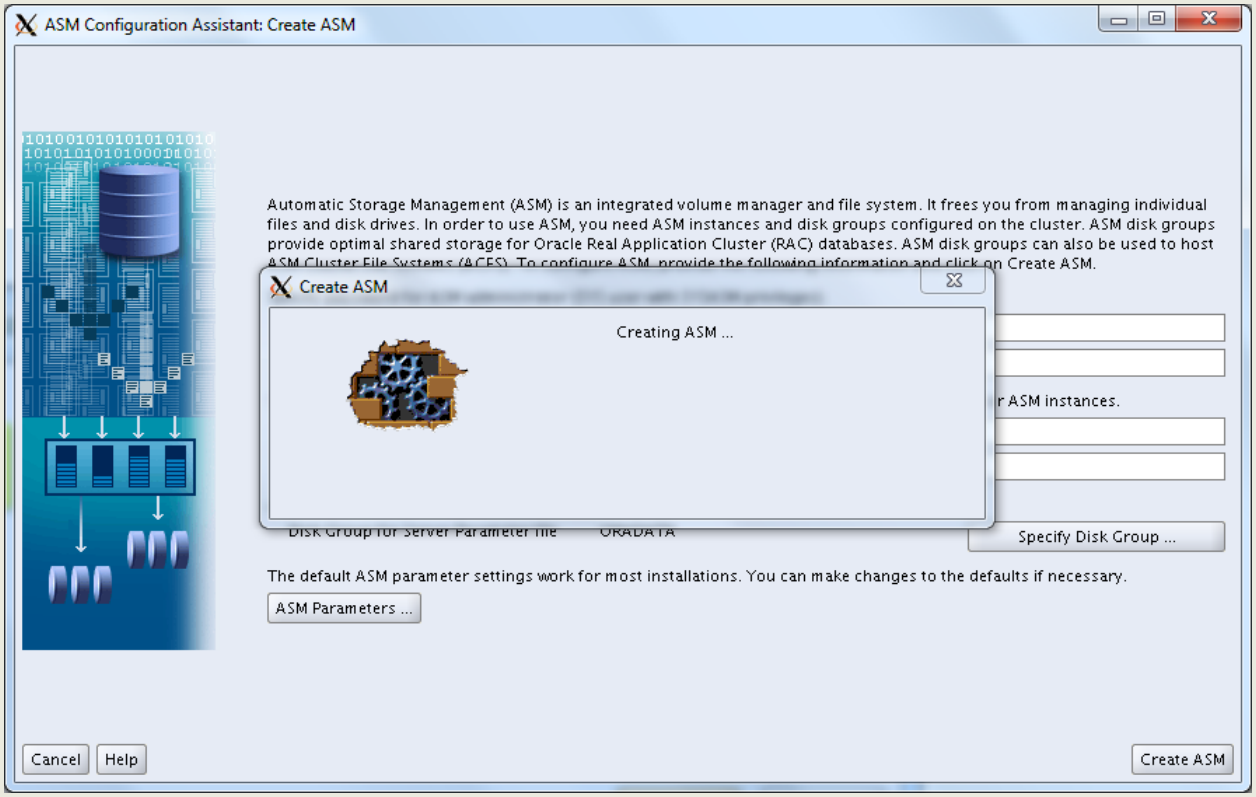

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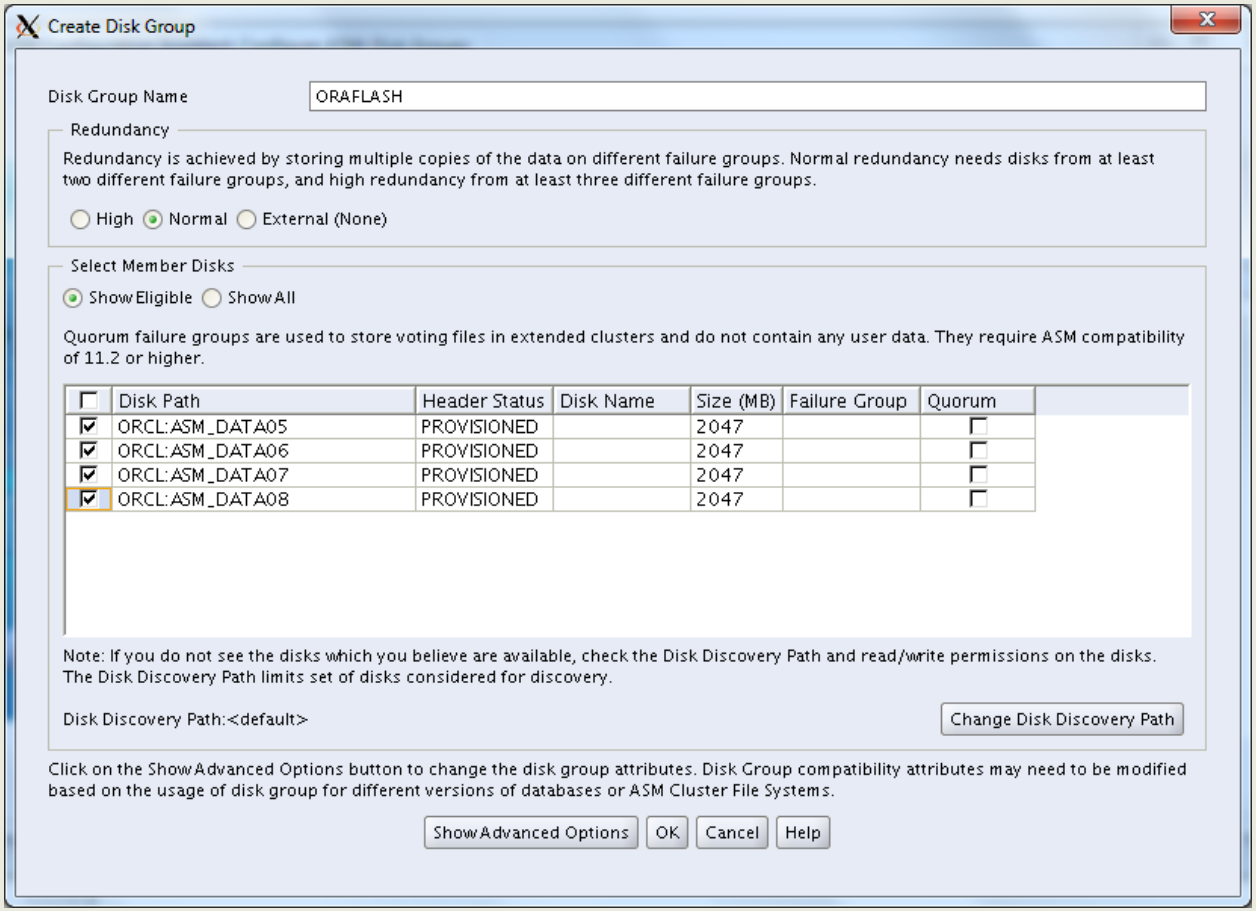
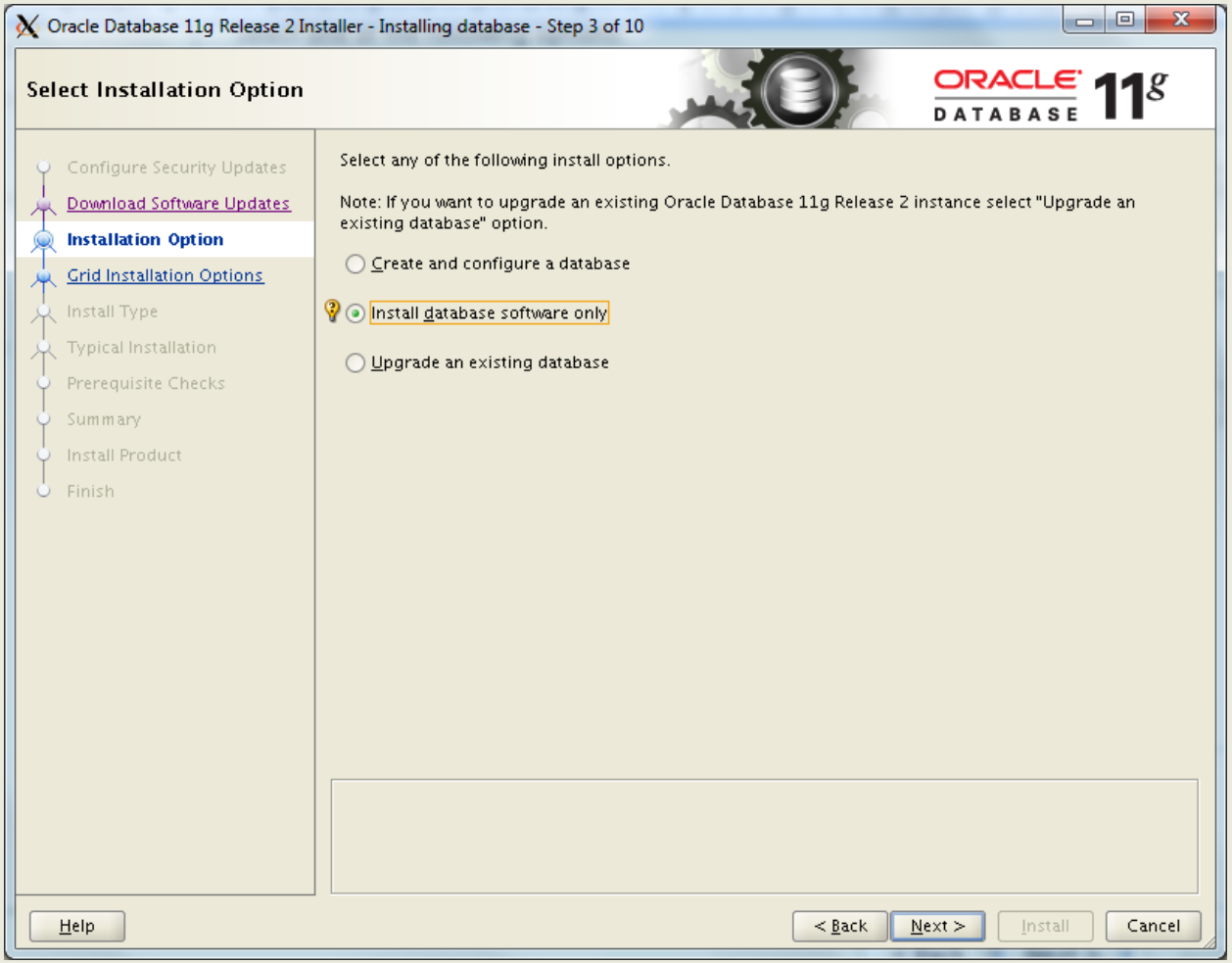


Database home install



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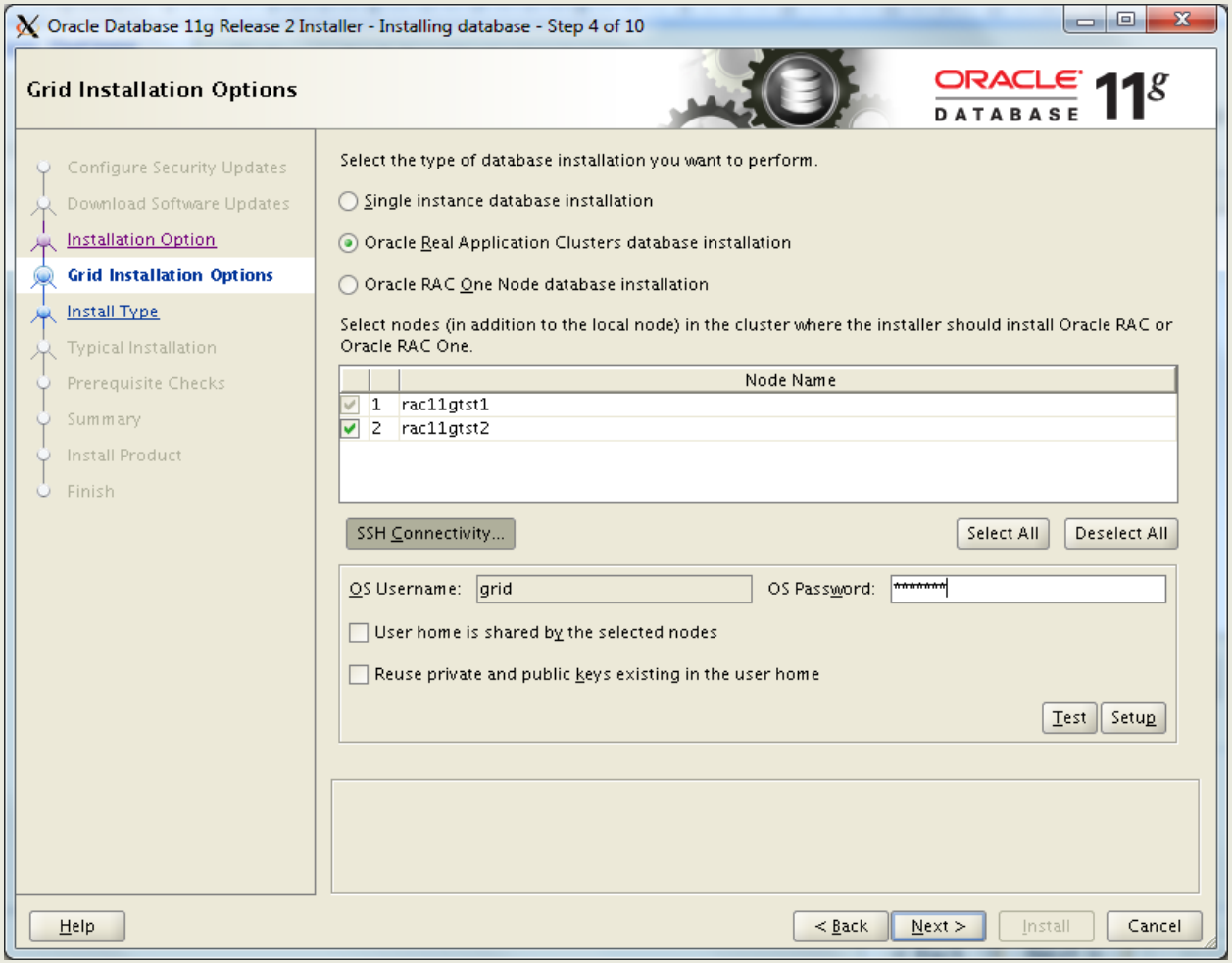

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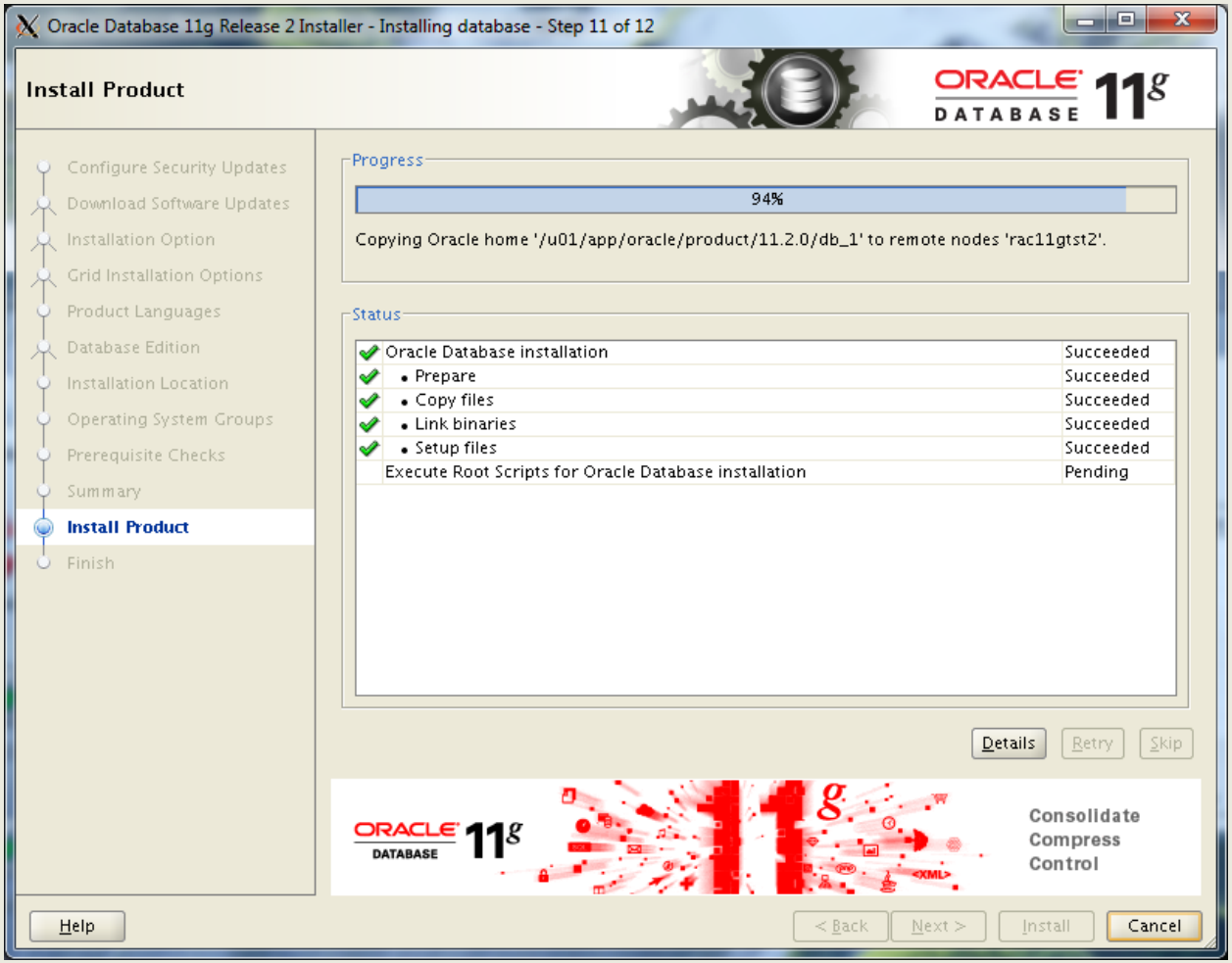
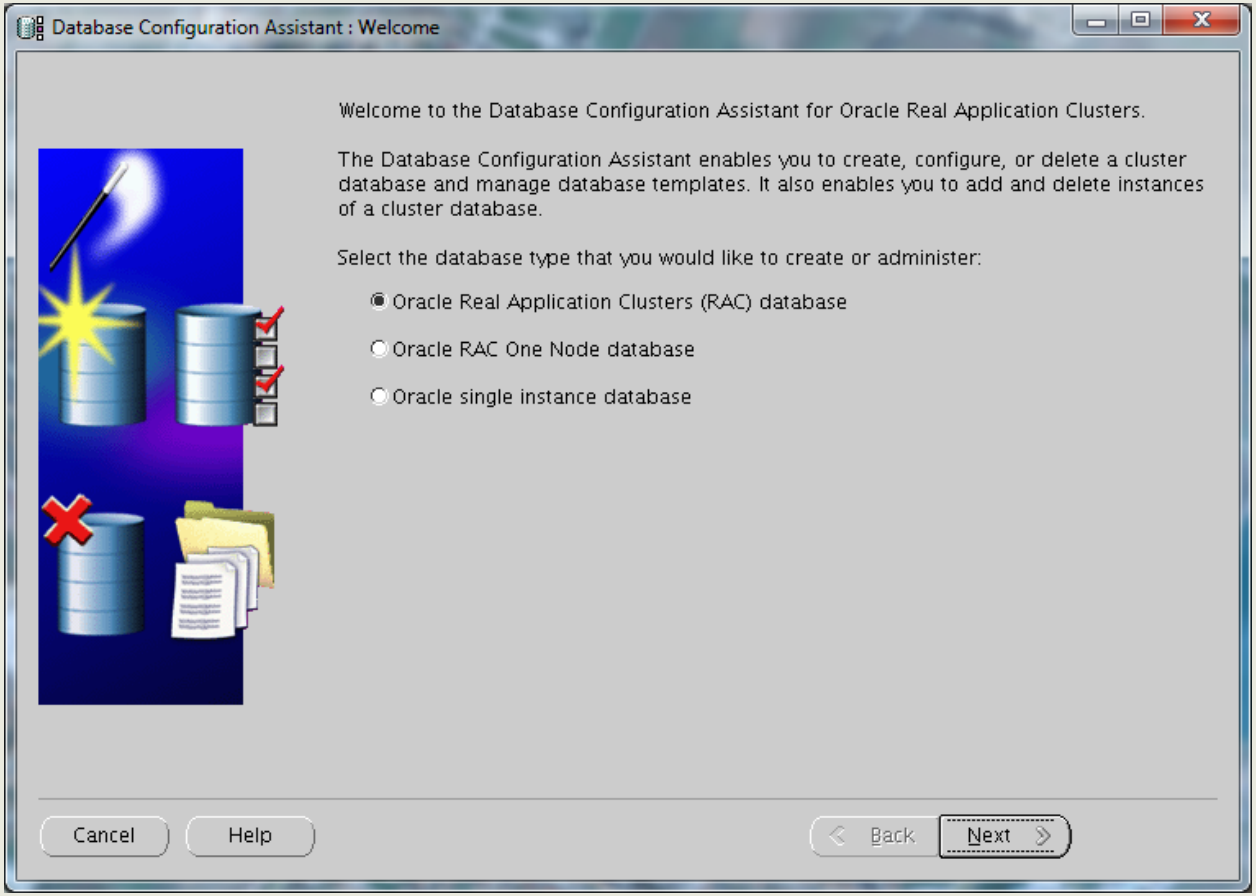


Create RAC database



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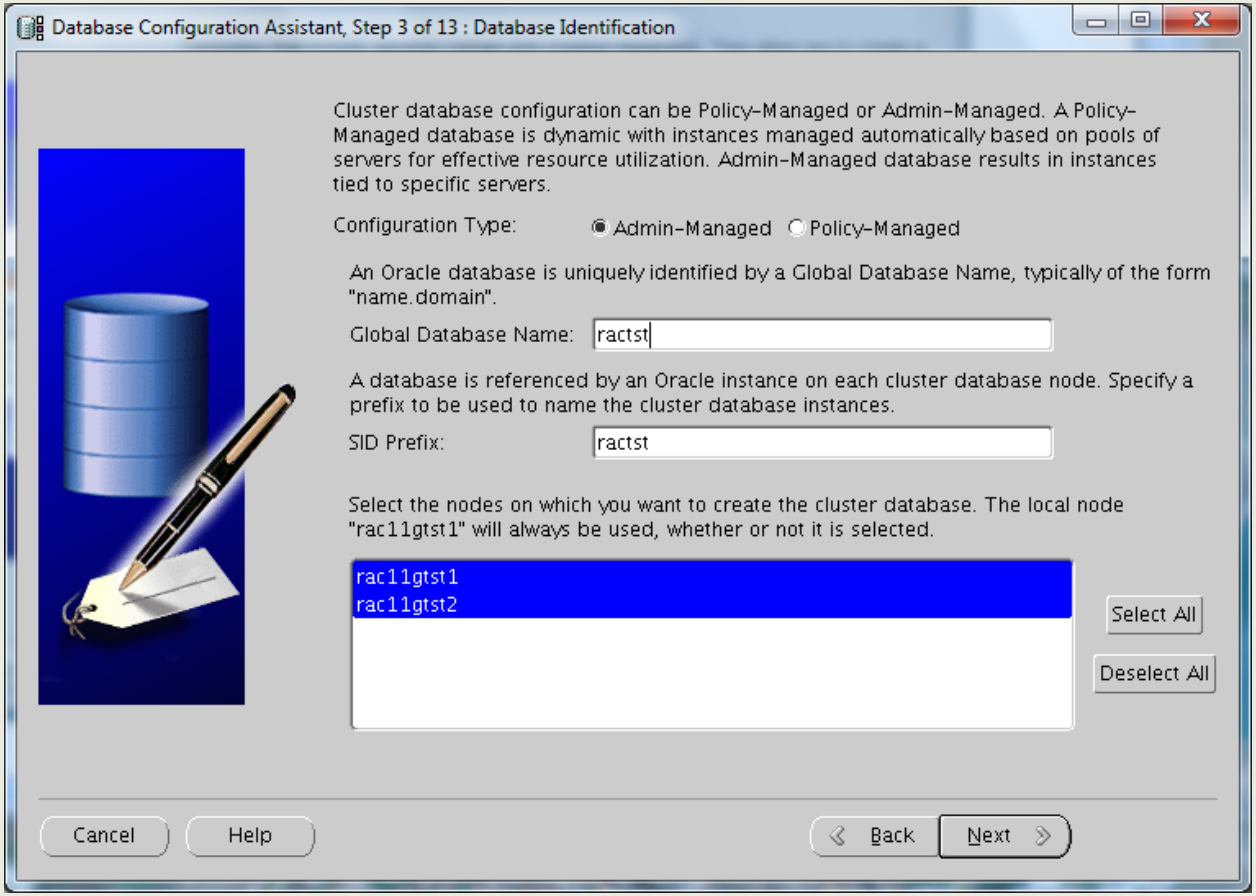

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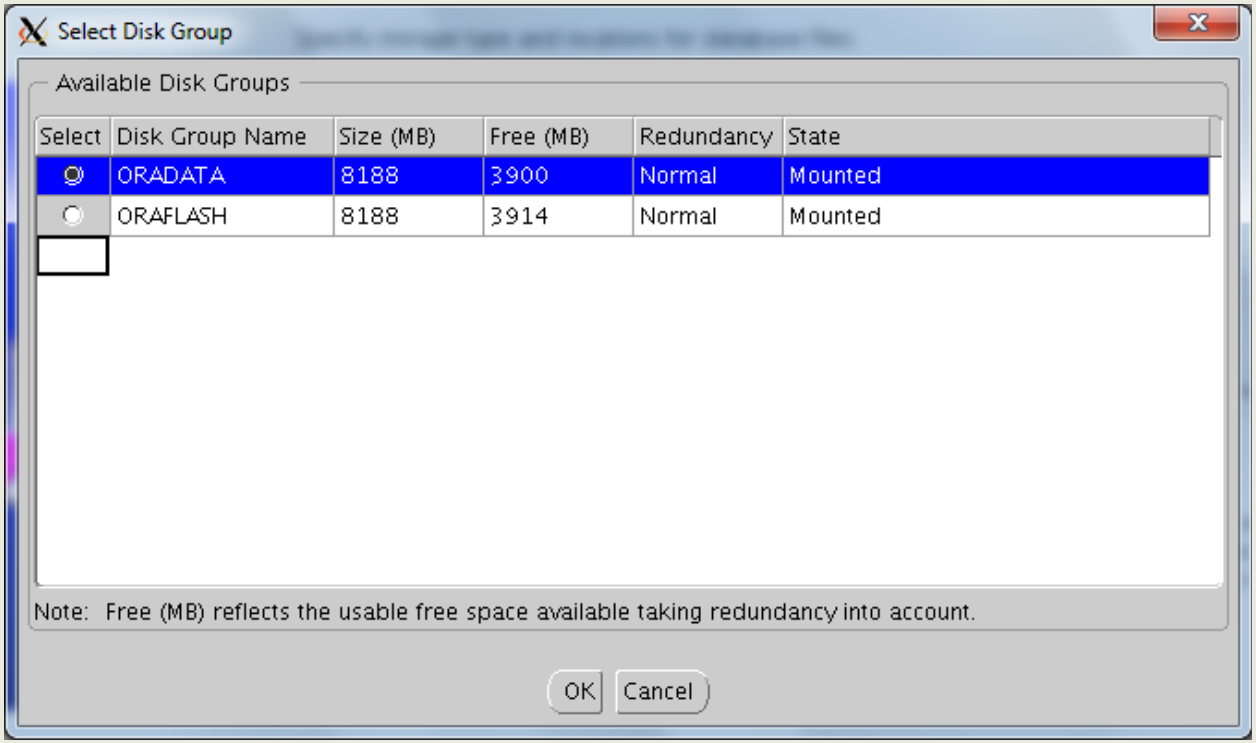

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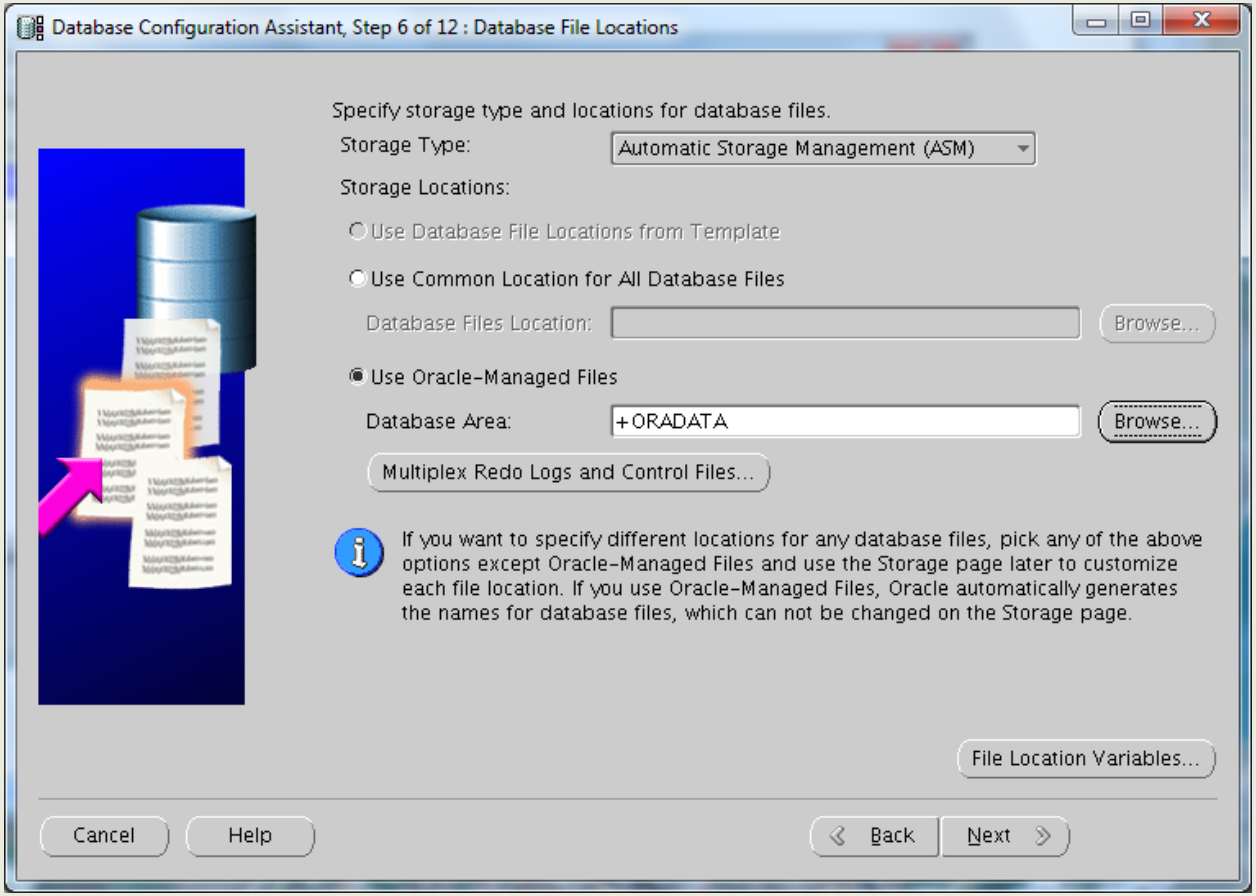

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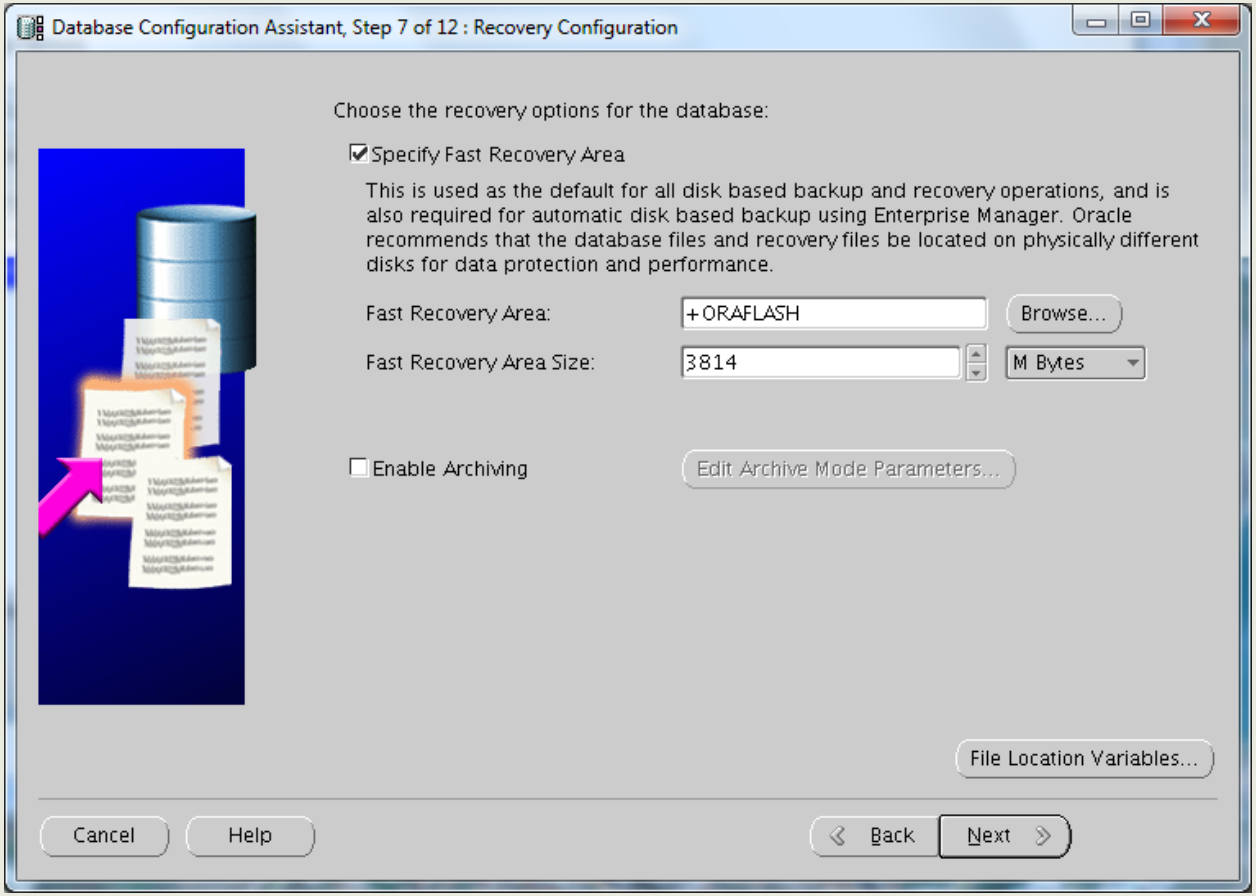

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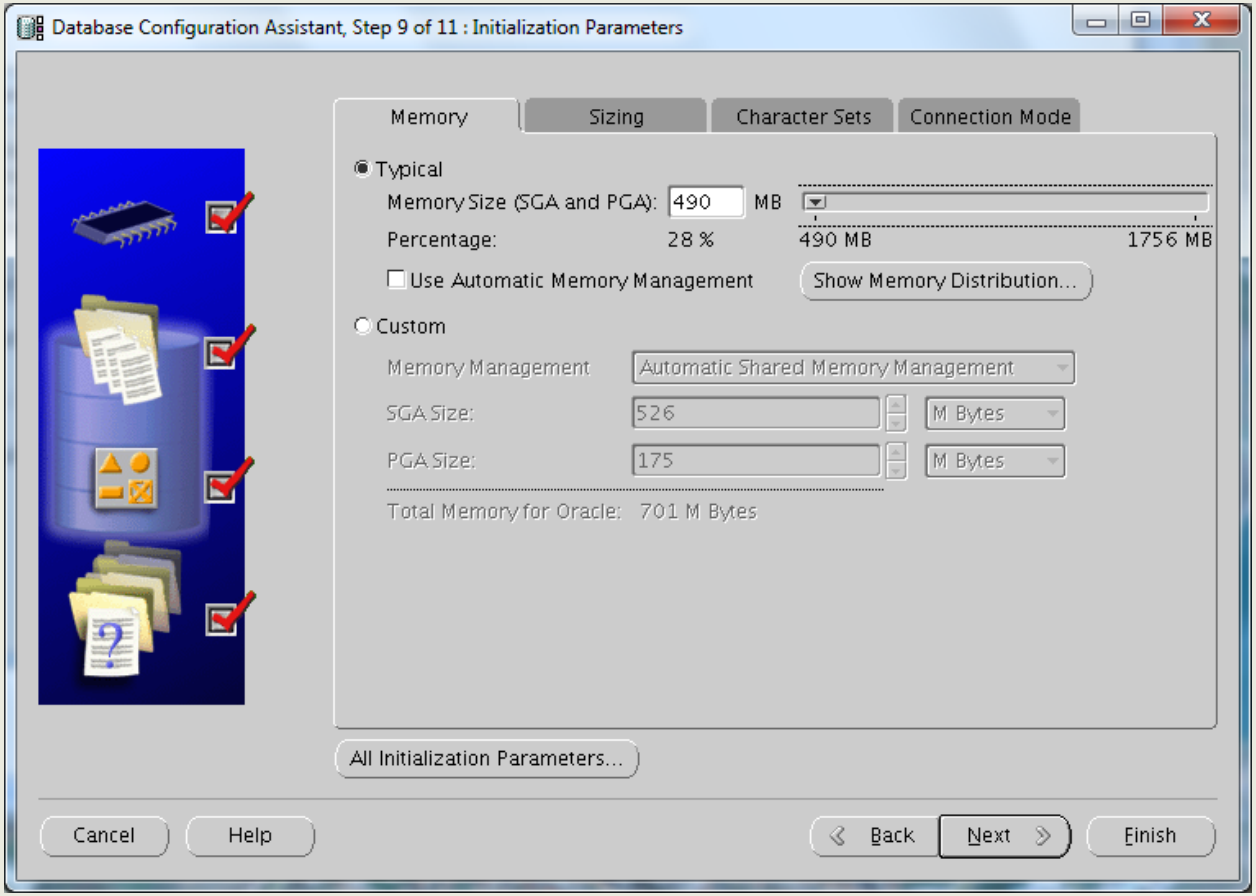

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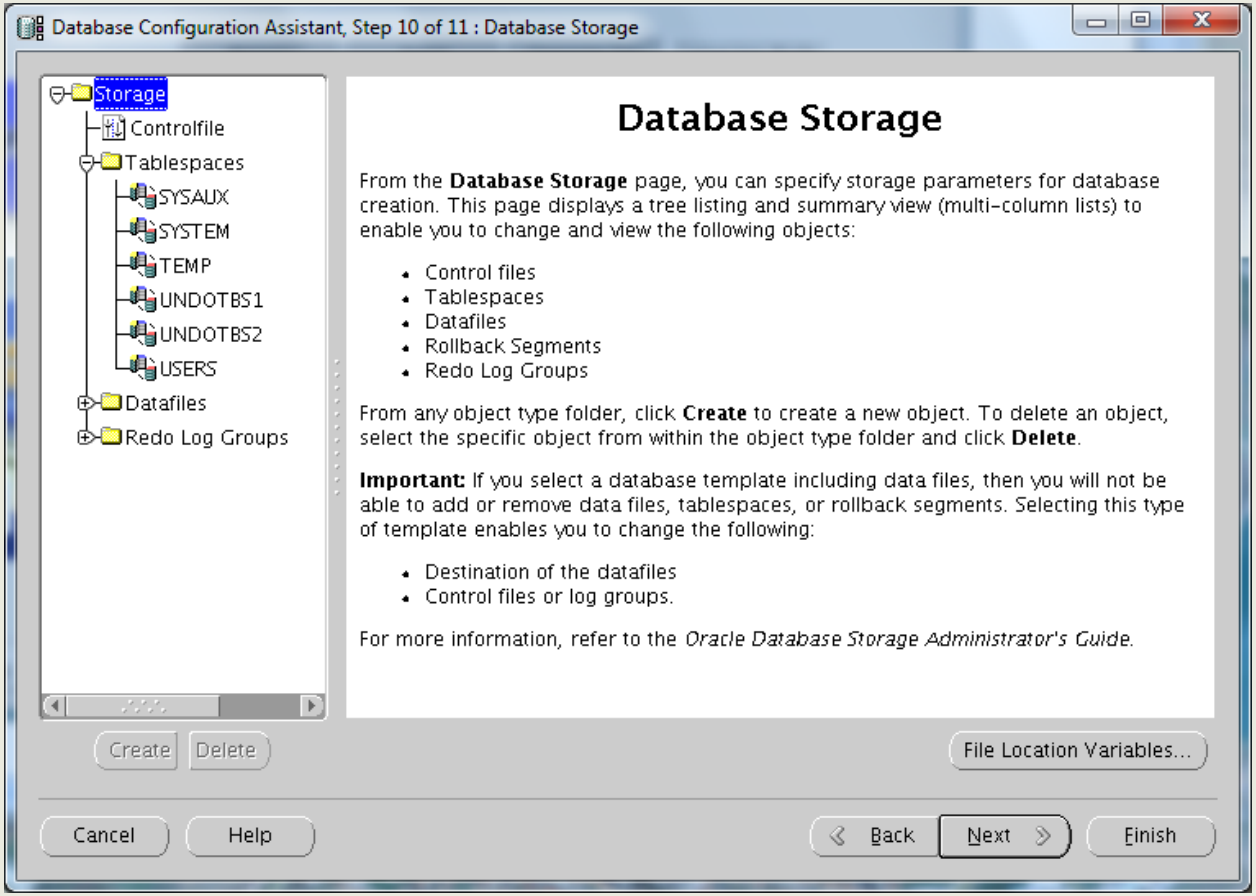


RAC system testing

I/O throughput verification with Orion tool

- simulate the type of IO's an OLTP or DSS system does
- response times in terms of IOPS and MBPS.

Swingbench tool

- Stress and benchmark testing database

Real Application testing

- Capture application workload on pre 11g database and replay on 11g
- Used for migration to 11g testing

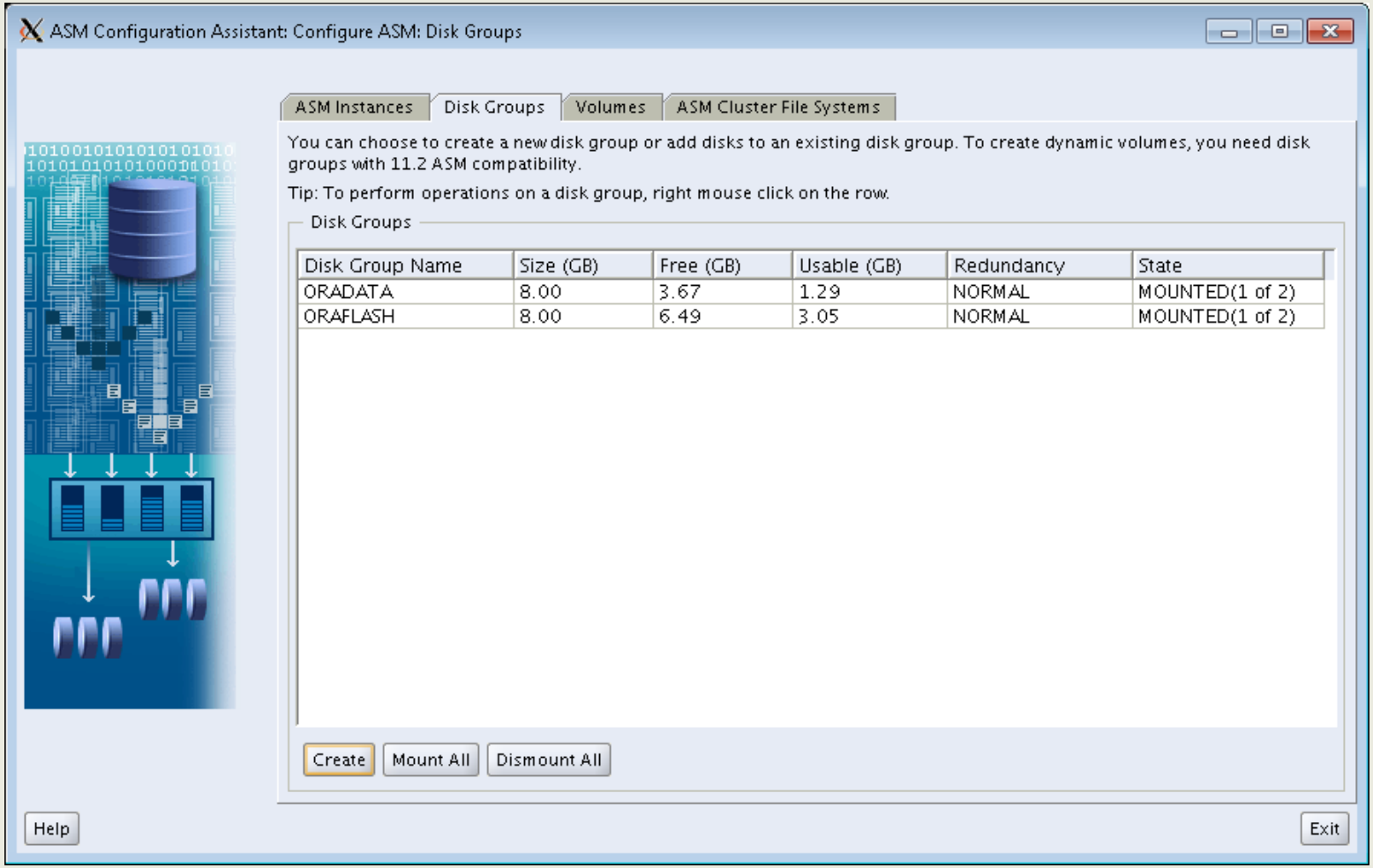
Postinstallation steps

- Develop patching strategy
- Configure backup and recovery
- Monitor and tune database performance

Exercise:
Create ASM disk group ORADATA2

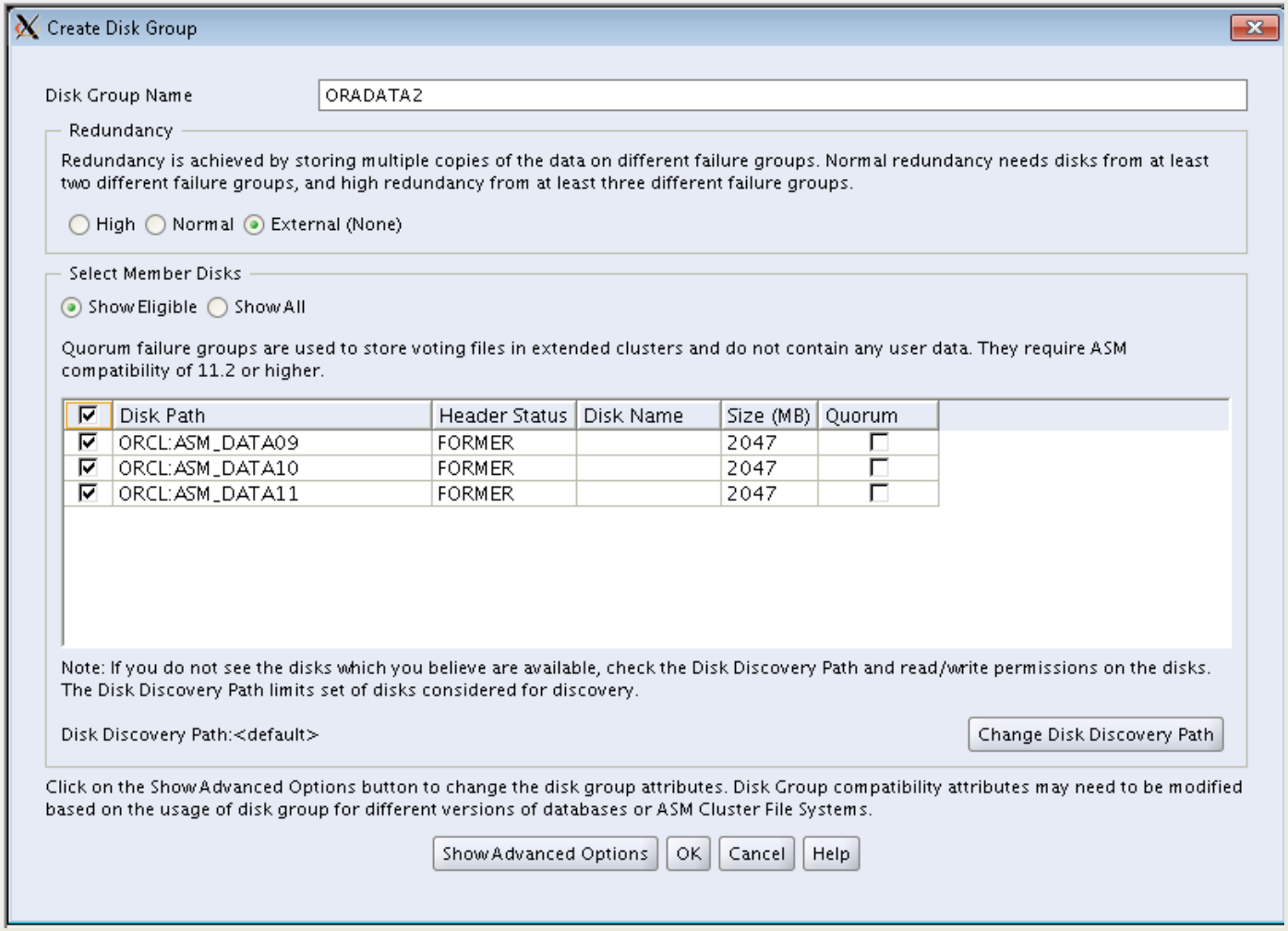
- Prerequisites:
  - ASM instance on rac11gtst1 must be up and running
- Actions
  - Connect to server rac11gtst1 as user grid and execute:
    $ srvctl status asm
    ASM instance must be up
    Start ASM Configuration Assistant
    $ asmca

Exercise:
Create ASM disk group ORADATA2



Click on Create to continue

Exercise:
Create ASM disk group ORADATA2



Enter:
ORADATA2
Select:
External
Select all three disks

Click OK to Create disk group

Exercise:
Create ASM disk group ORADATA2

- Check status of disk group ORADATA2 with:
  $ srvctl status diskgroup -g ORADATA2
  Disk Group ORADATA2 is running on rac11gtst1

Exercise:
Create single instance databaze rconv

- Connect to server rac11gtst1 as user oracle and execute:
  $. rconv.env
  $ dbca

Exercise:
Create single instance databaze rconv

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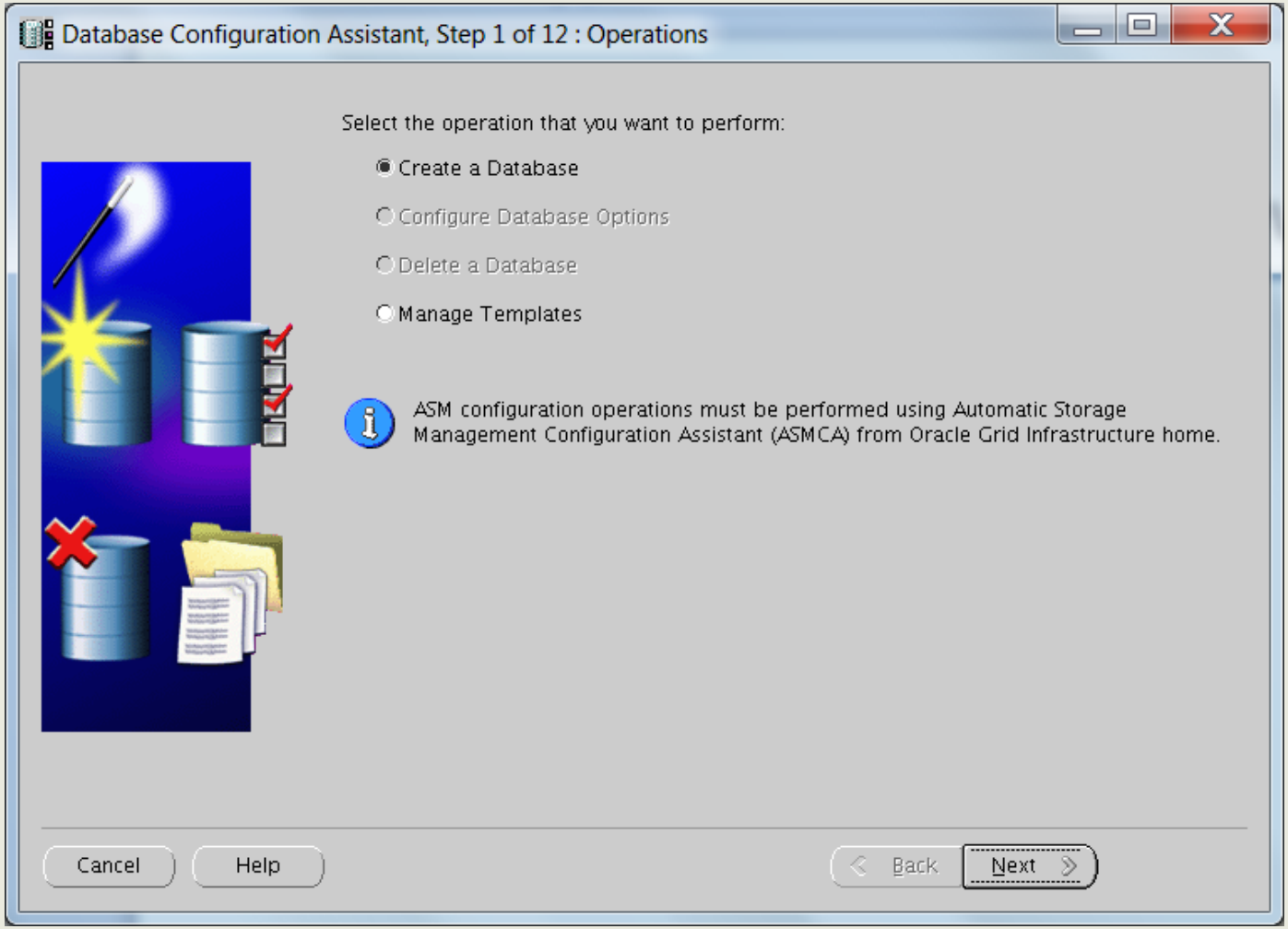
Create single instance databaze rconv



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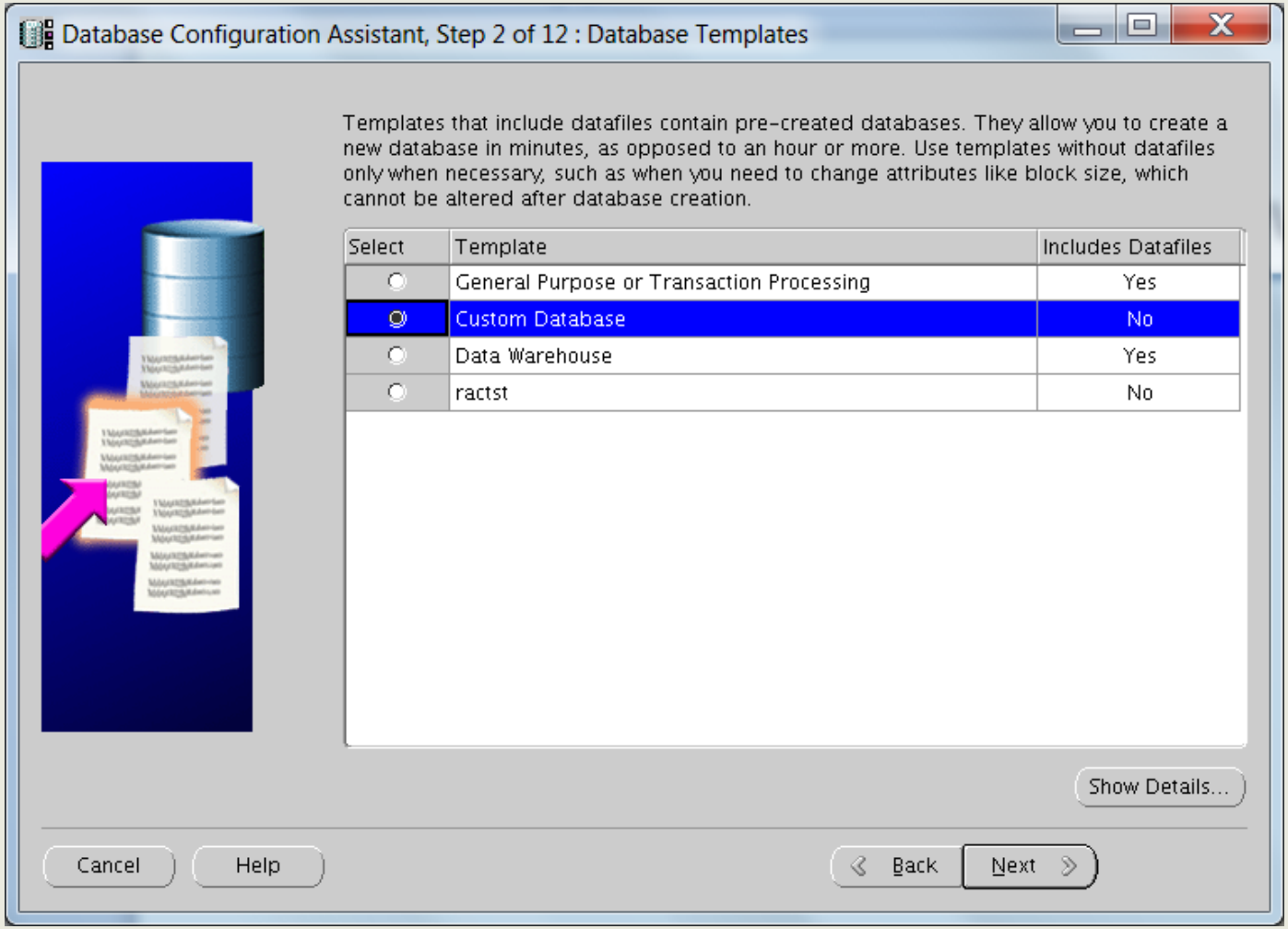
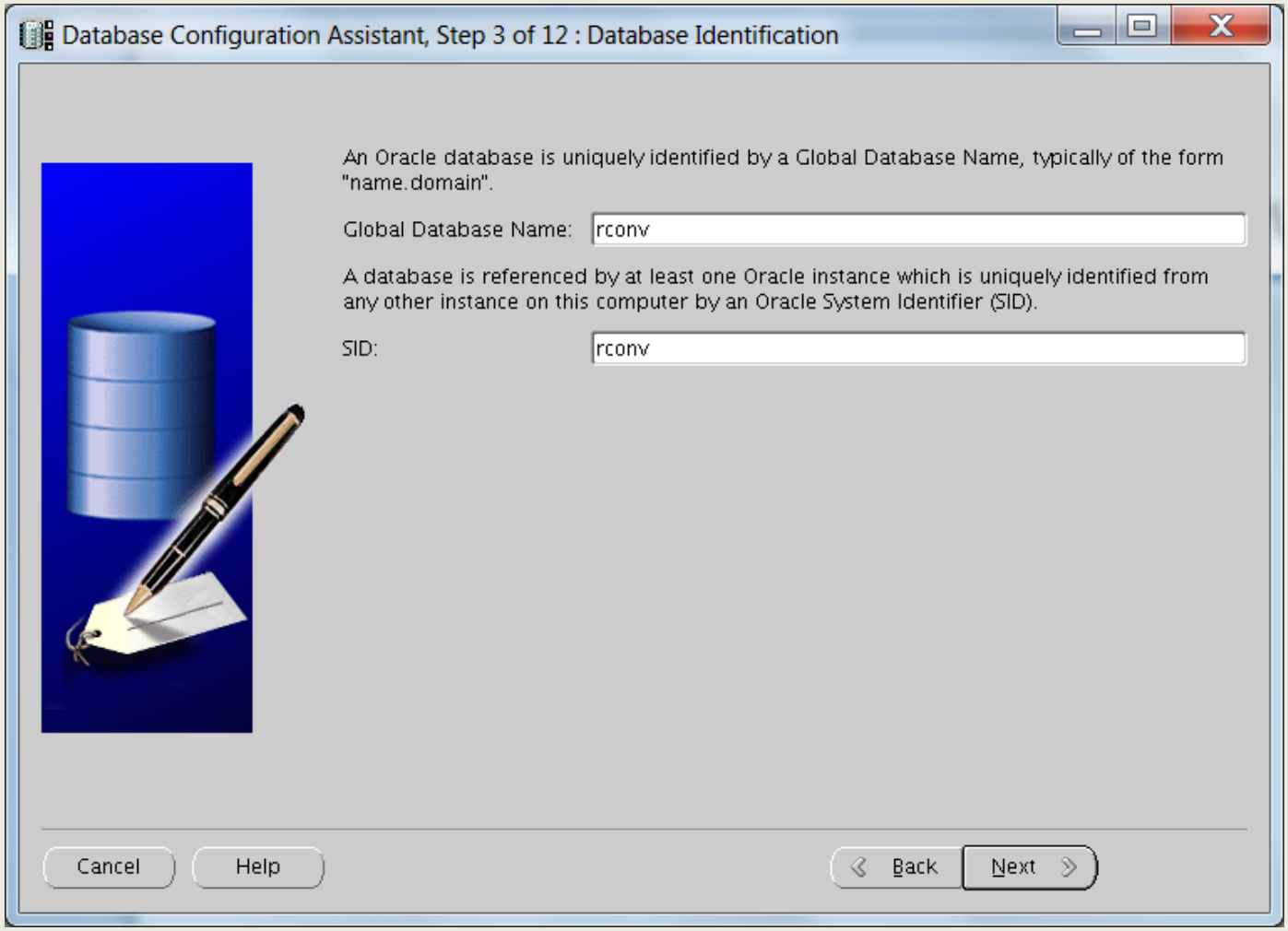
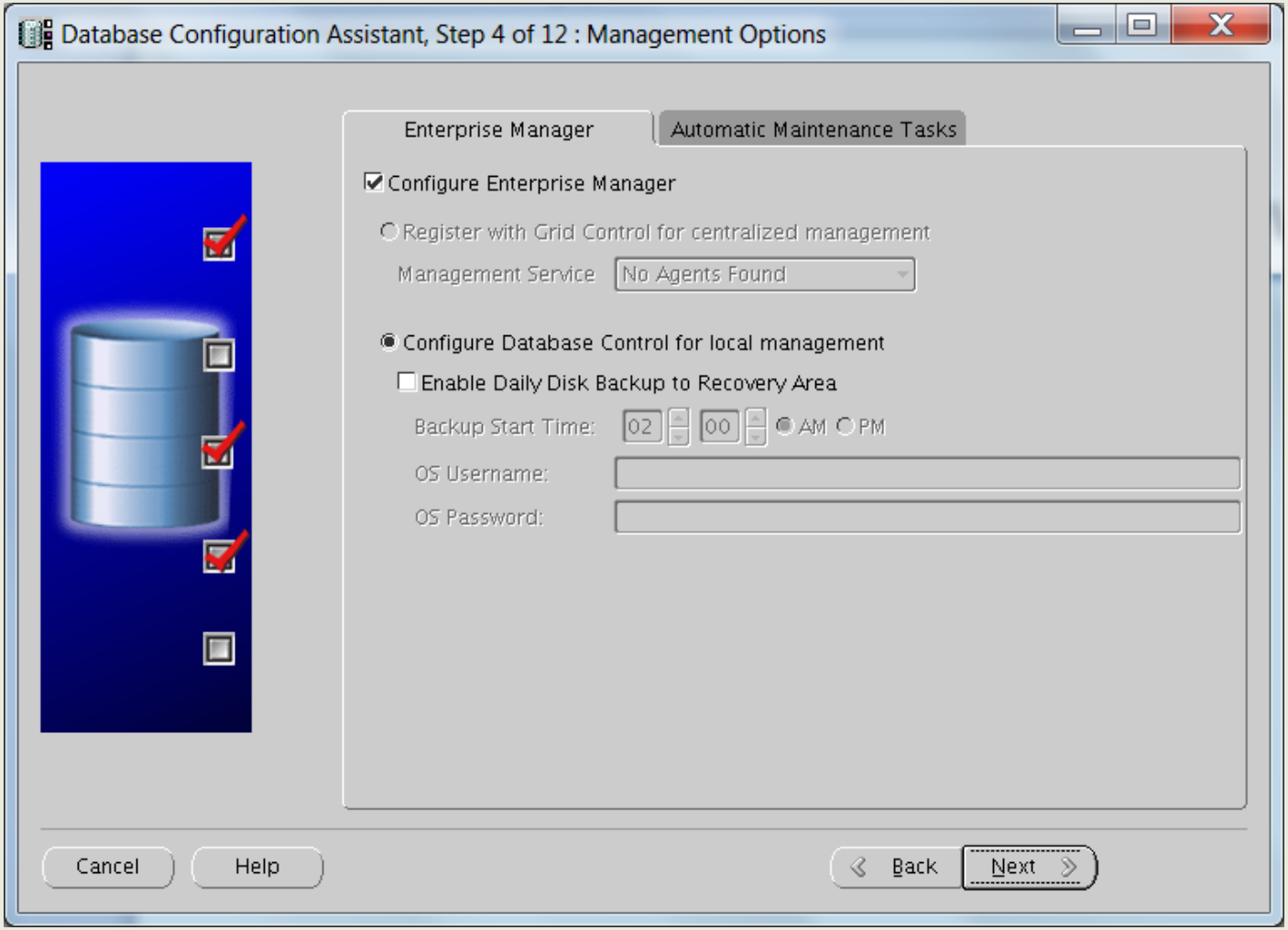


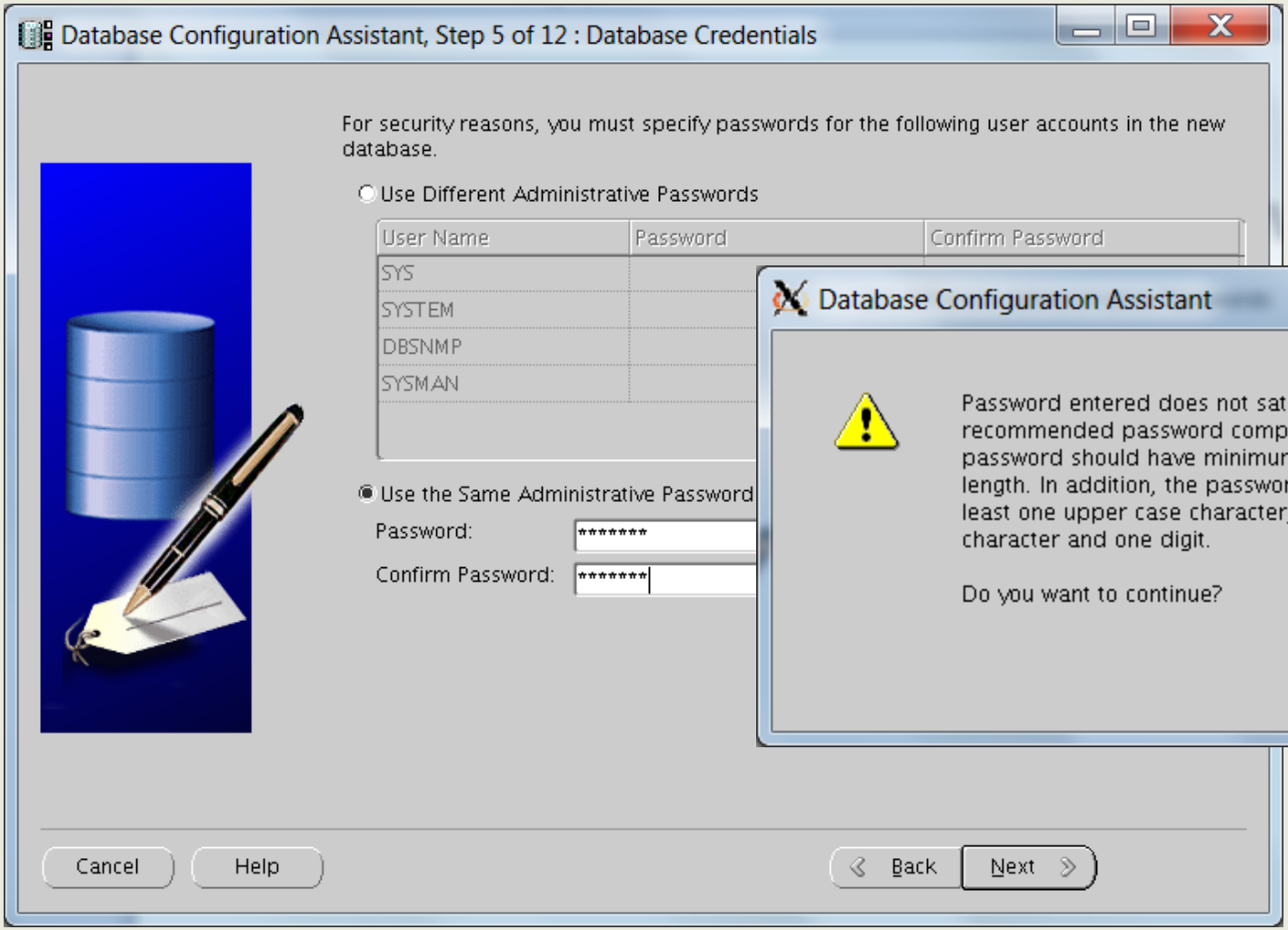
Exercise:
Create single instance databaze rconv



Exercise:
Create single instance databaze rconv

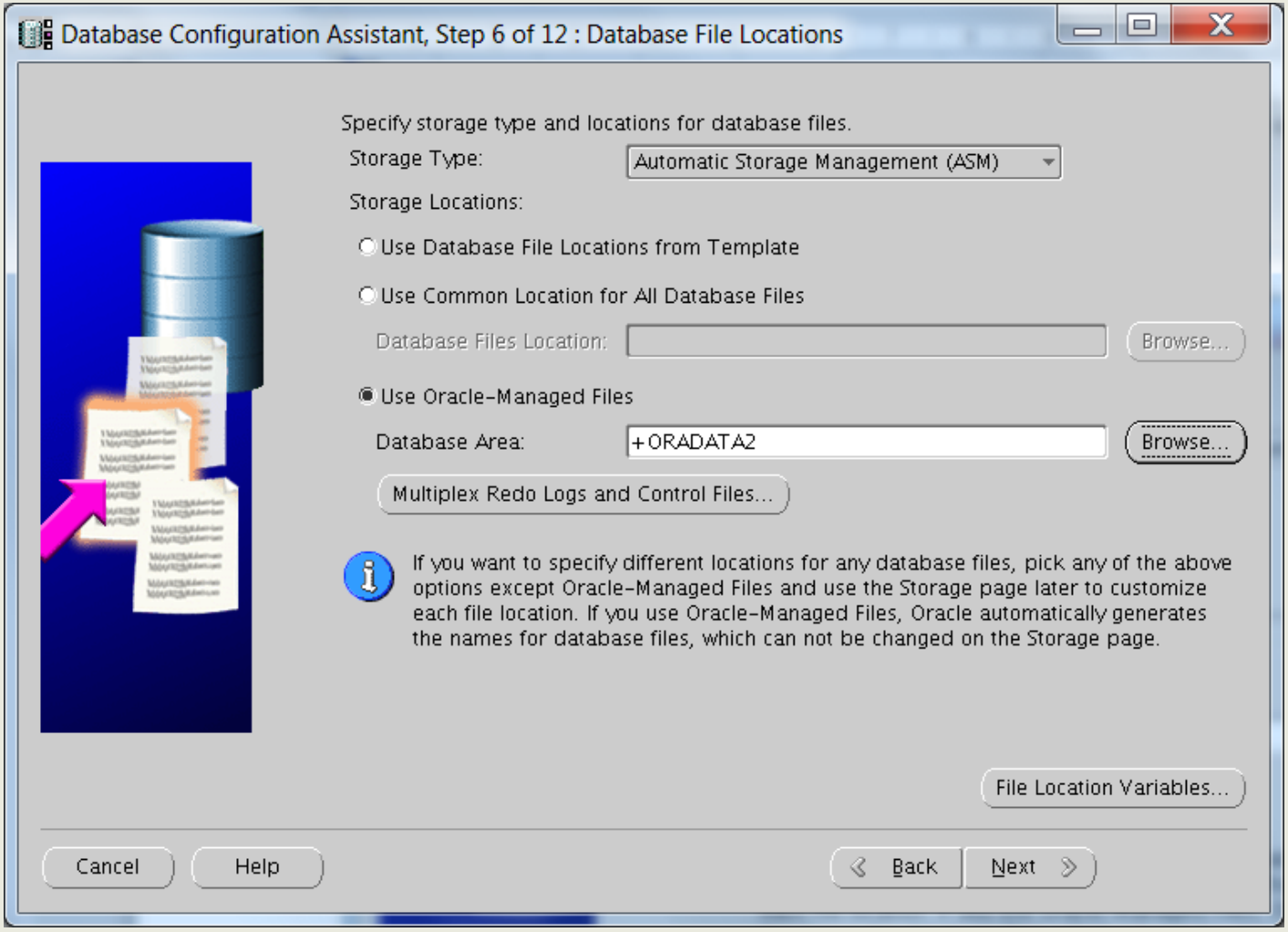


Exercise:
Create single instance databaze rconv

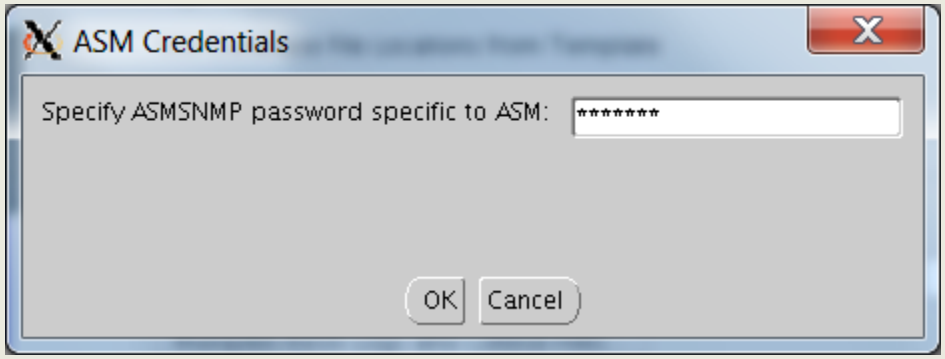


Password for all users is ractst1

Exercise:
Create single instance databaze rconv

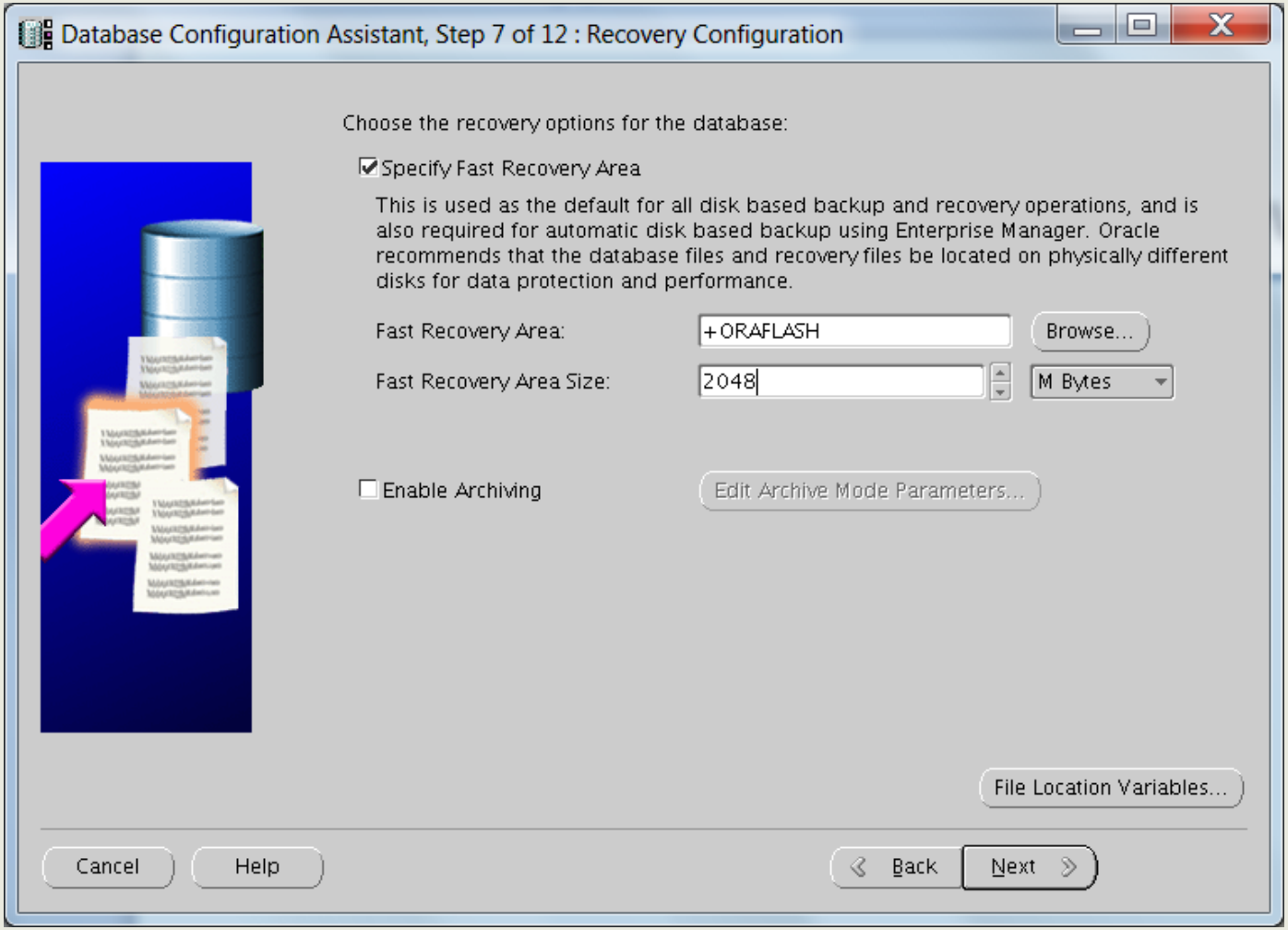


Exercise:
Create single instance databaze rconv

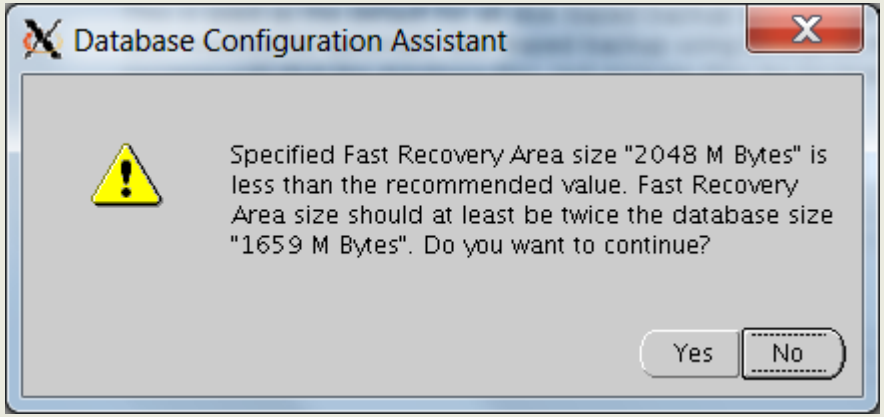


Password is ractst1

Exercise:
Create single instance databaze rconv

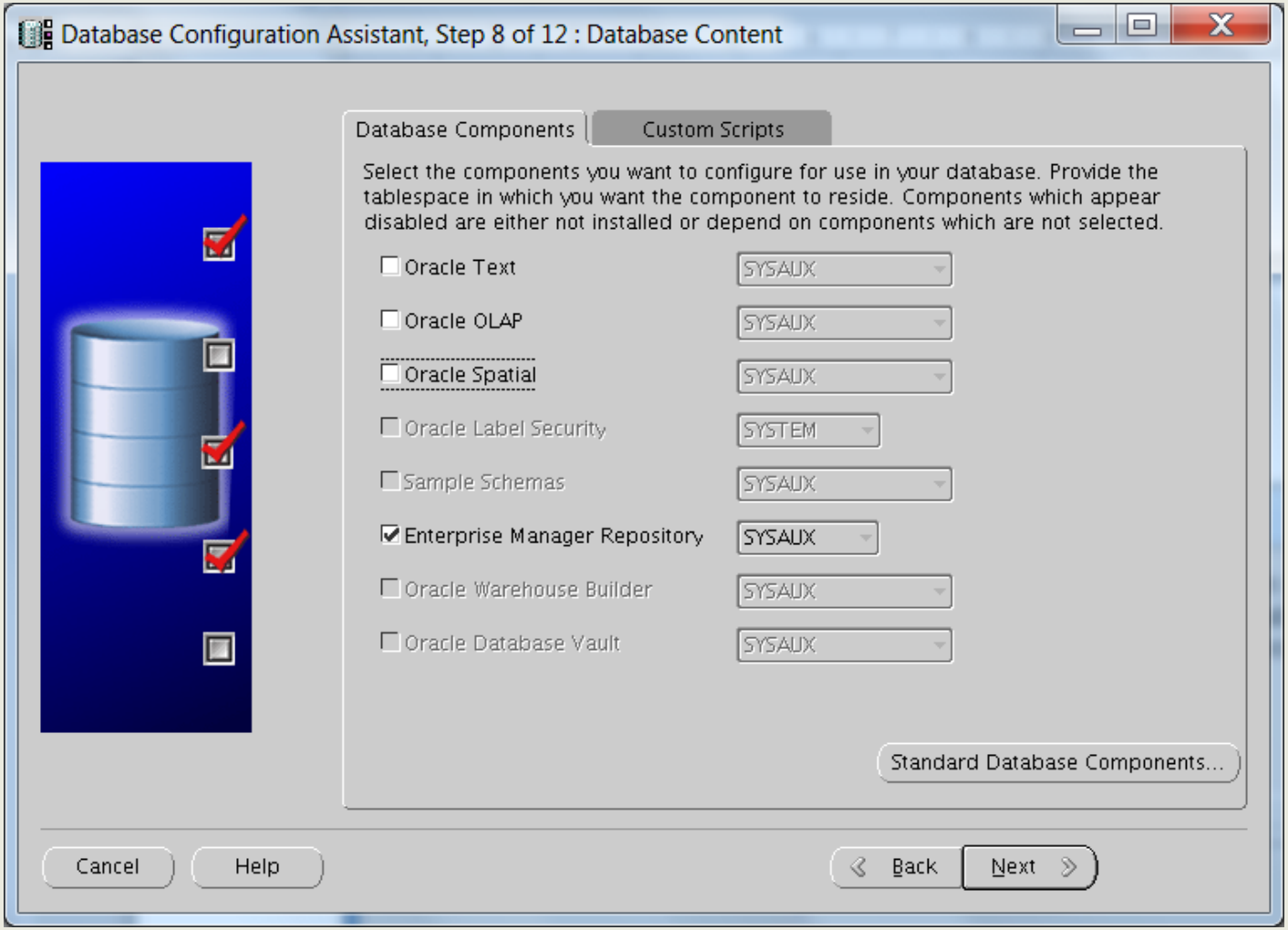


Exercise:
Create single instance databaze rconv

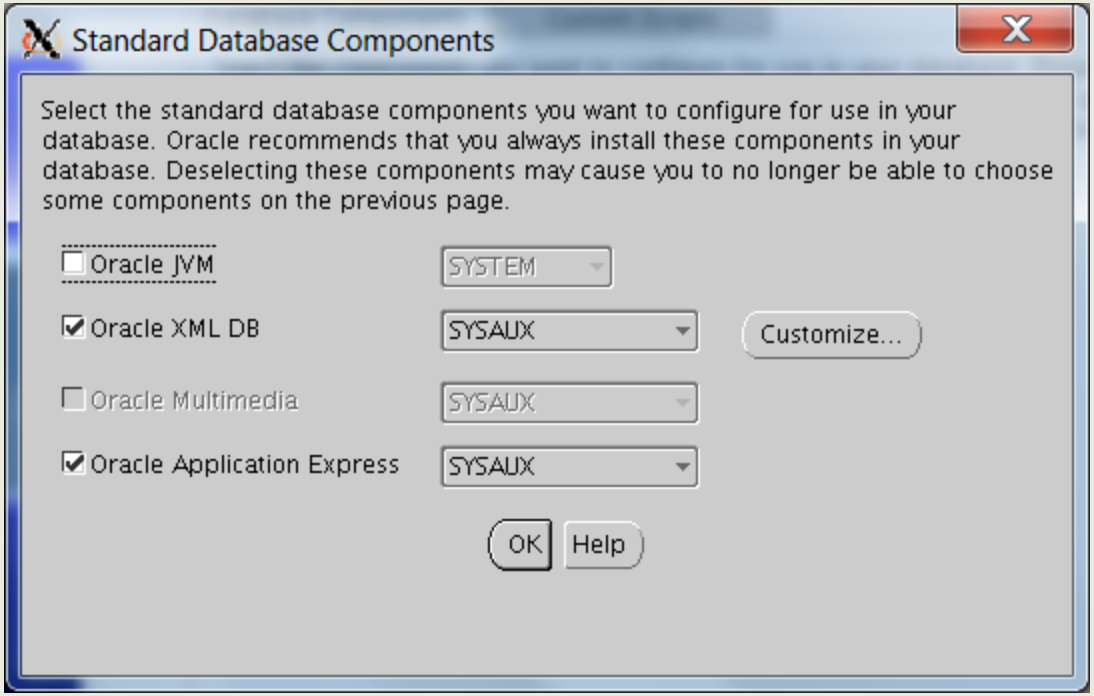


Click on Yes to continue

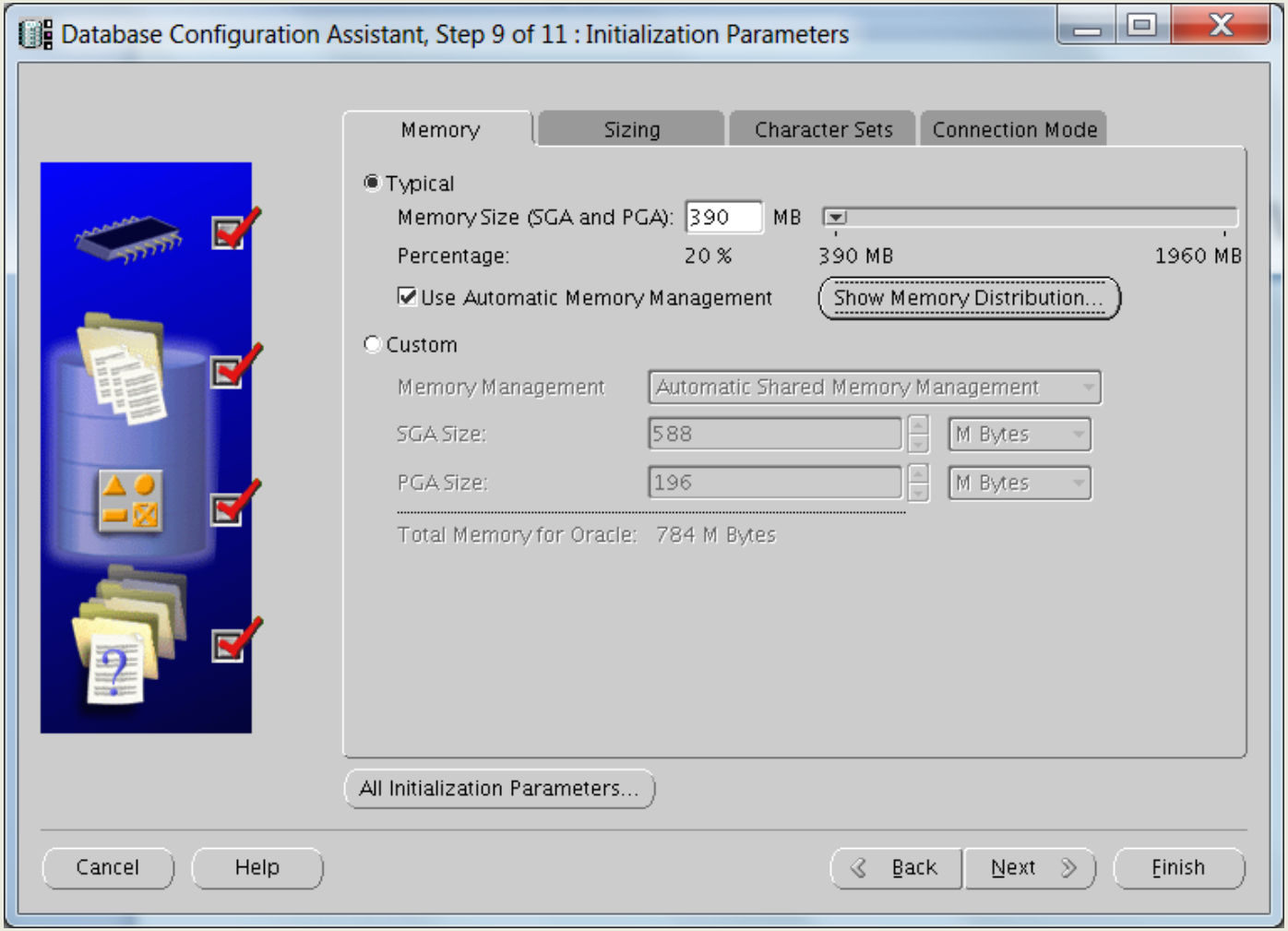
Exercise:
Create single instance databaze rconv



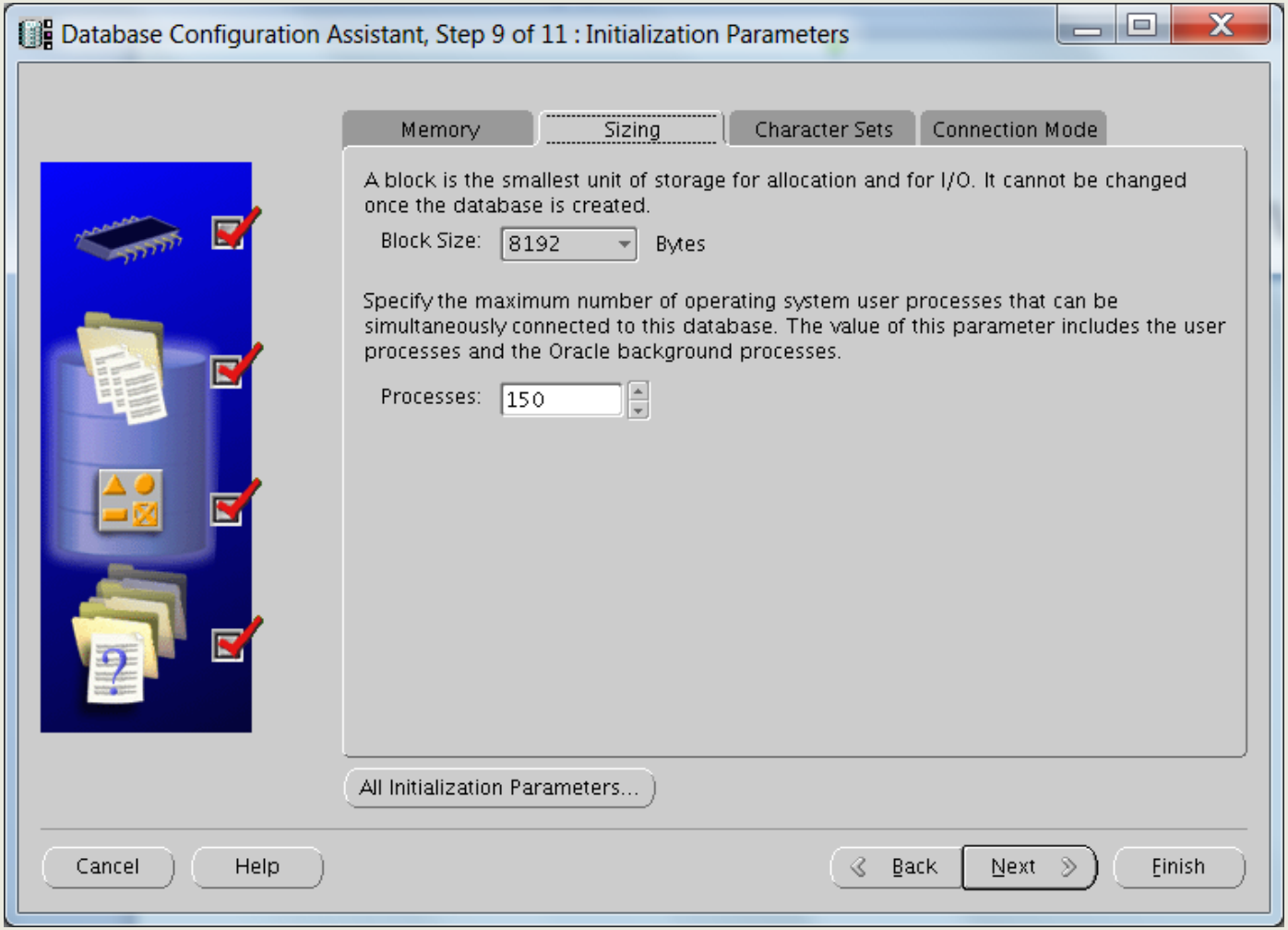
Exercise:
Create single instance databaze rconv



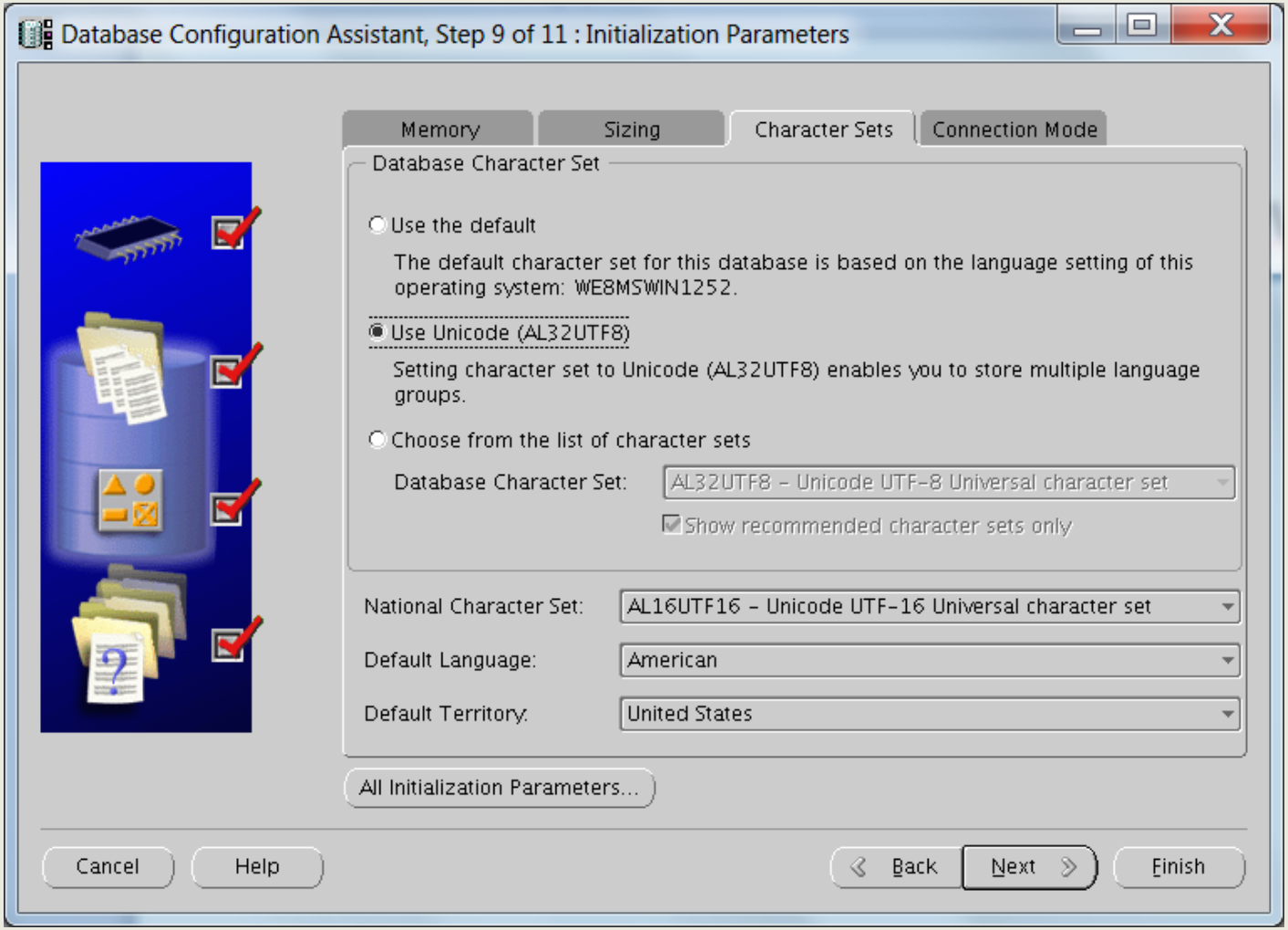
Exercise:
Create single instance databaze rconv



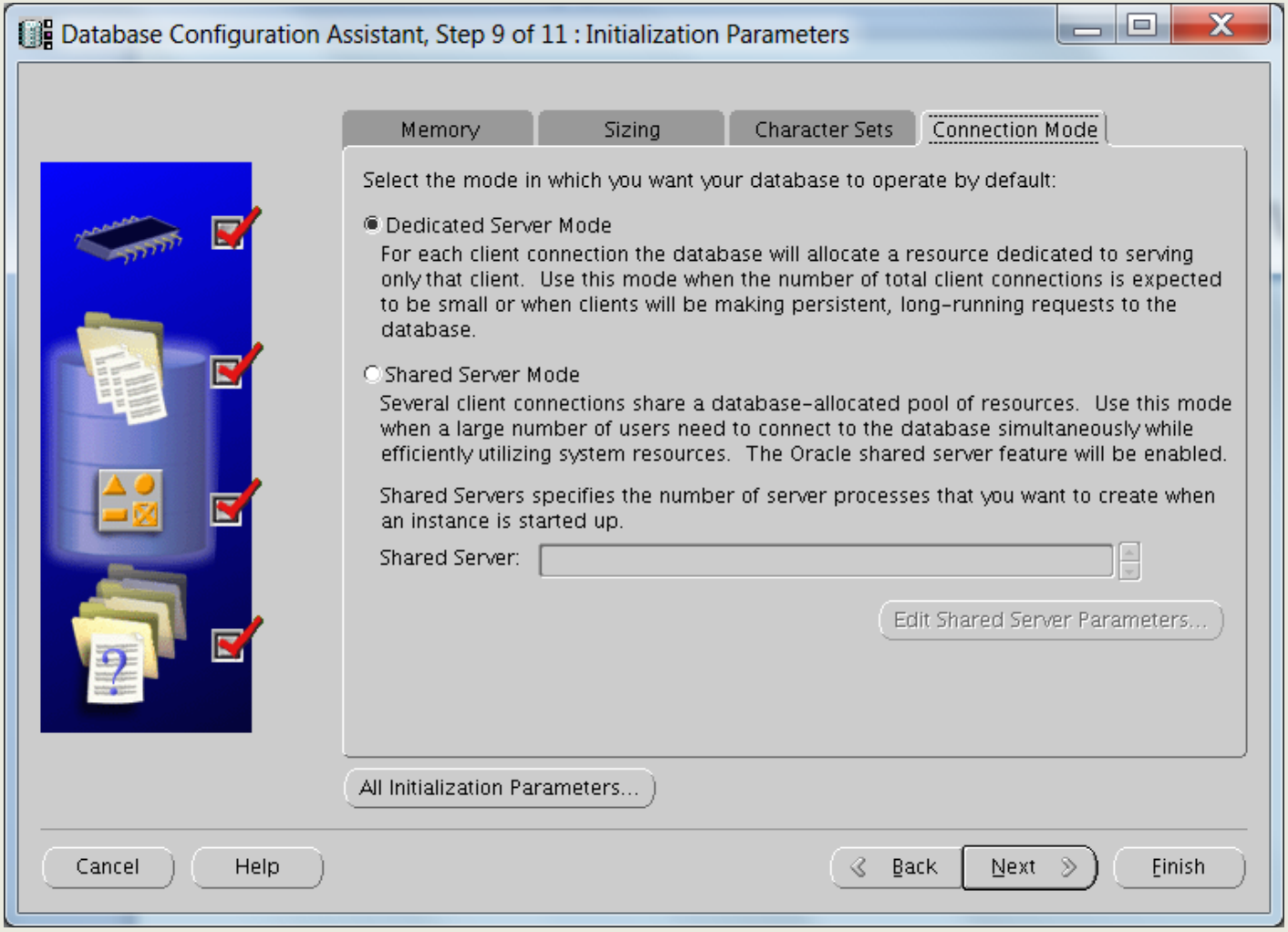
Exercise:
Create single instance databaze rconv



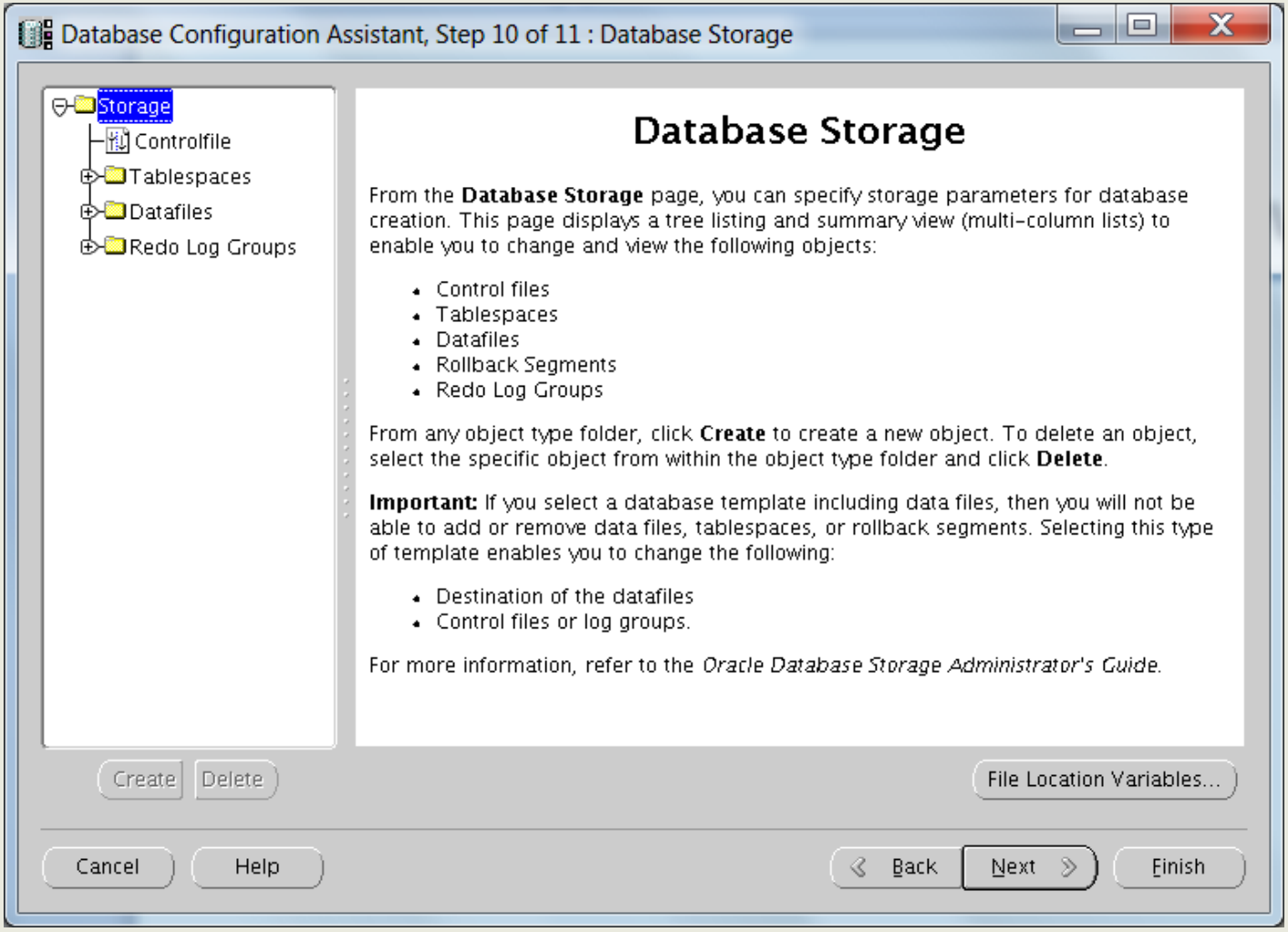
Exercise:
Create single instance databaze rconv



Exercise:
Create single instance databaze rconv

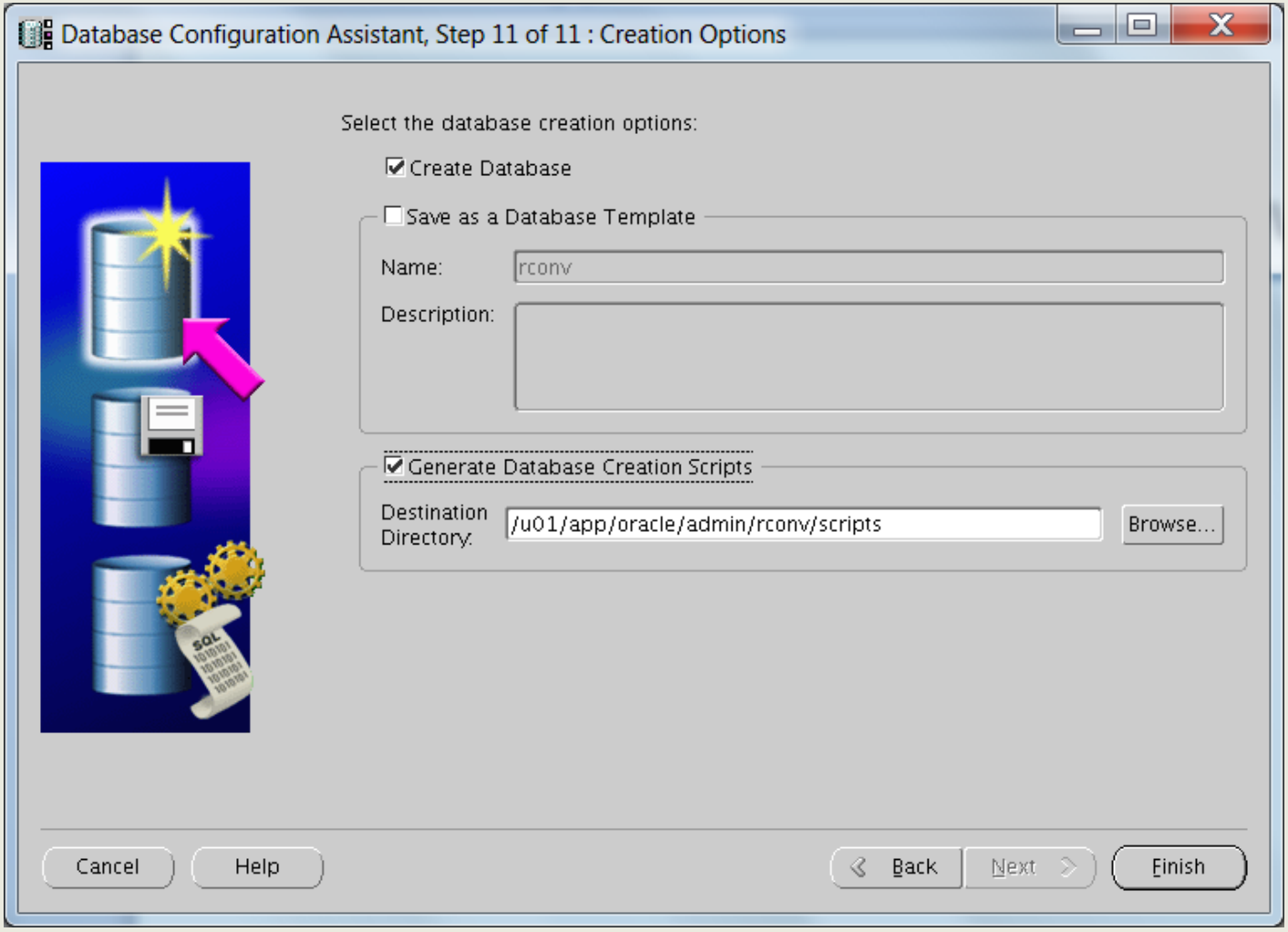


Exercise:
Create single instance databaze rconv

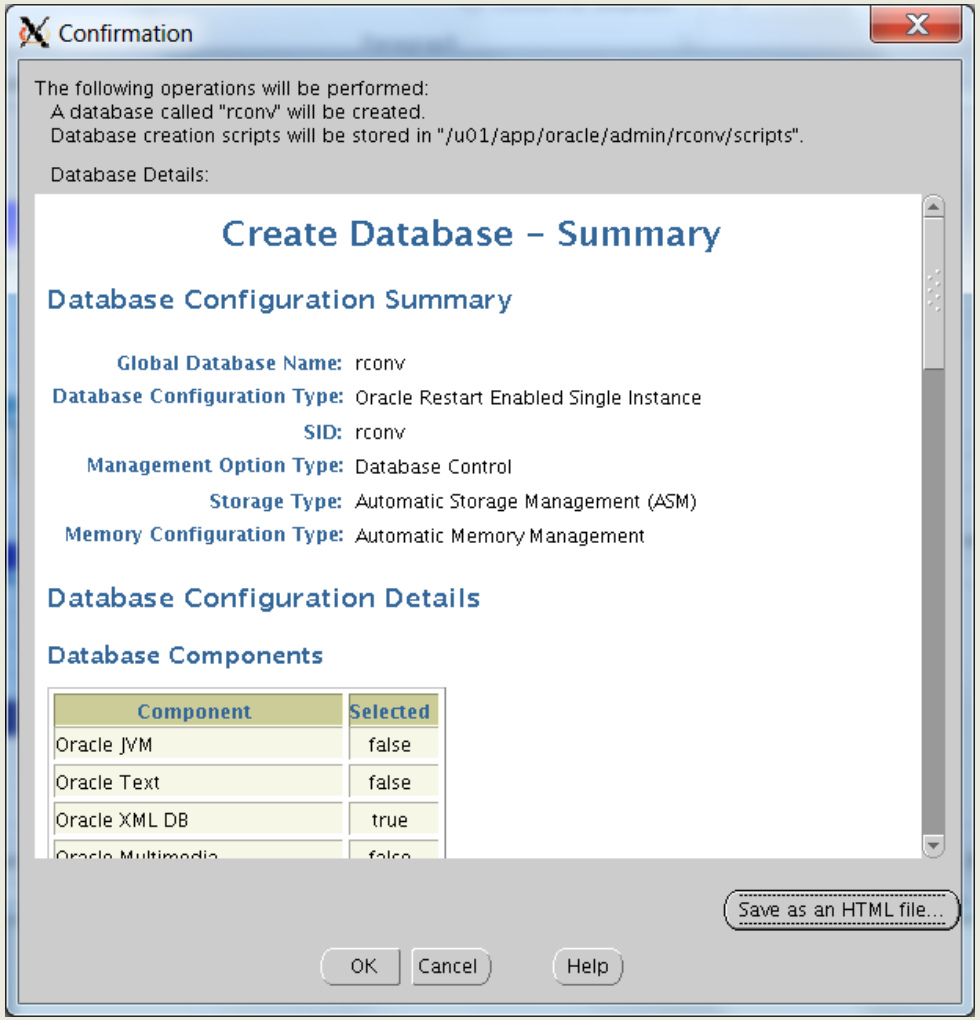


Do not change default datafile sizes

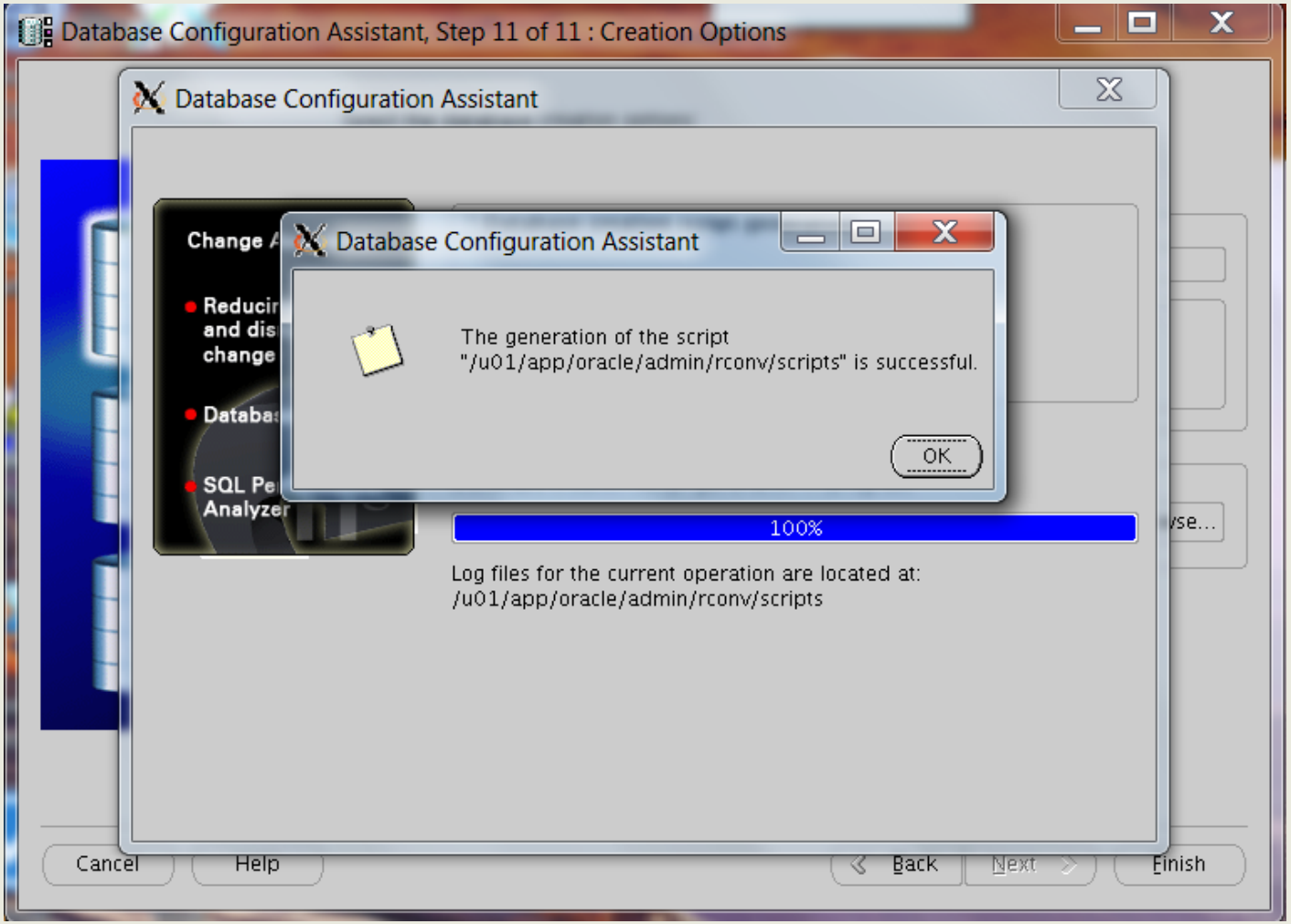
Exercise:
Create single instance databaze rconv



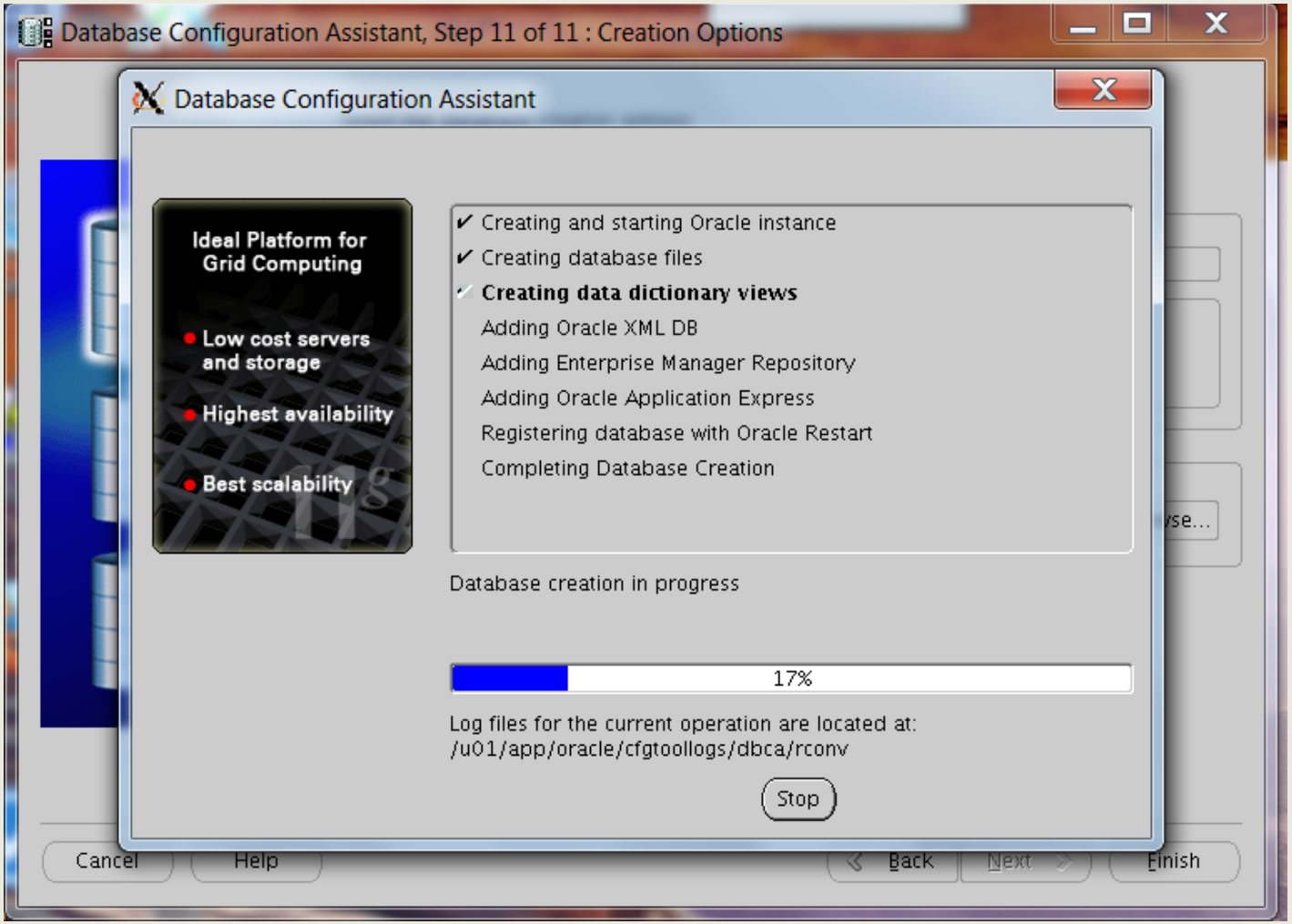
Exercise:
Create single instance databaze rconv



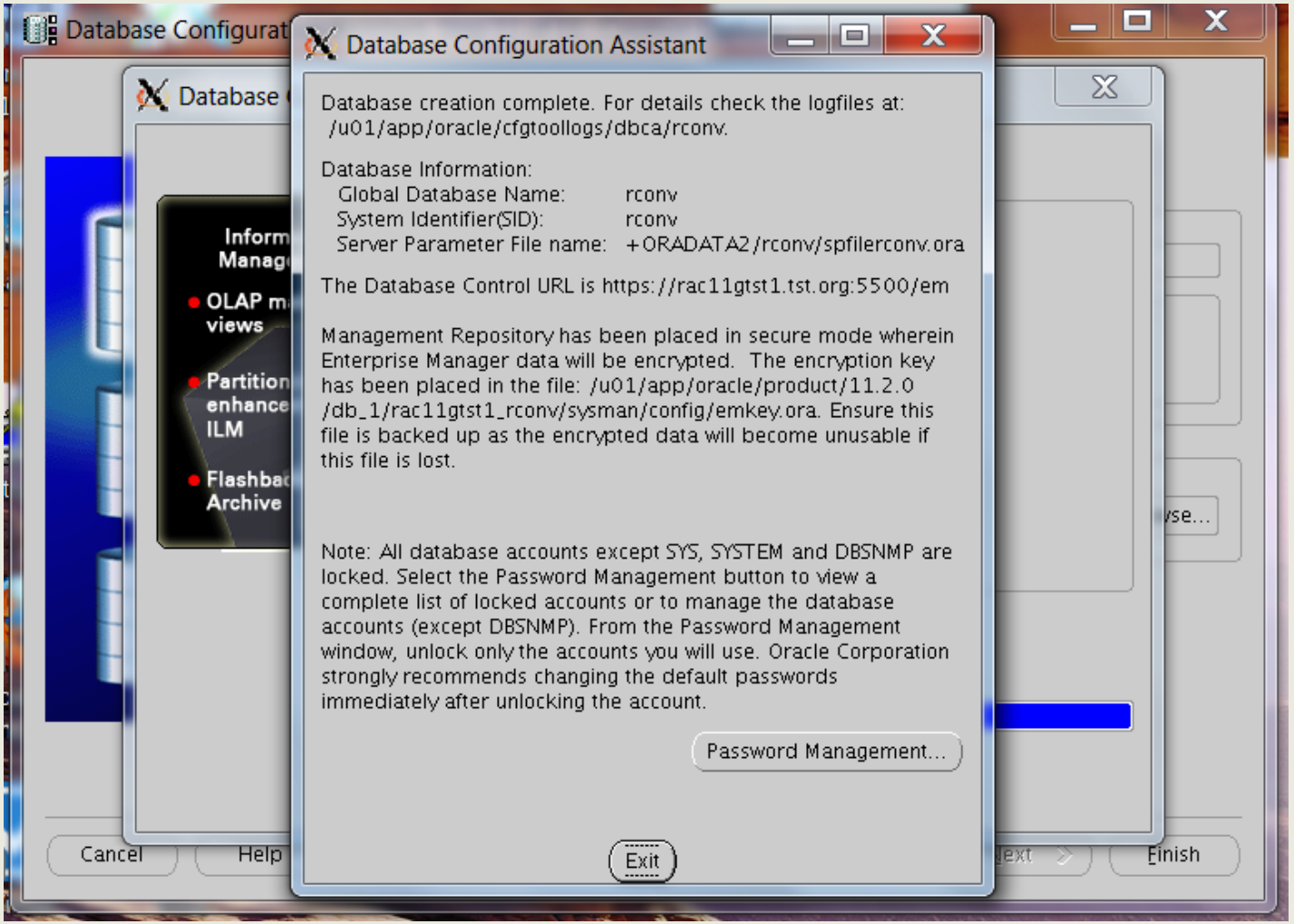
Exercise:
Create single instance databaze rconv



Exercise:
Create single instance databaze rconv



Exercise:
Create single instance databaze rconv



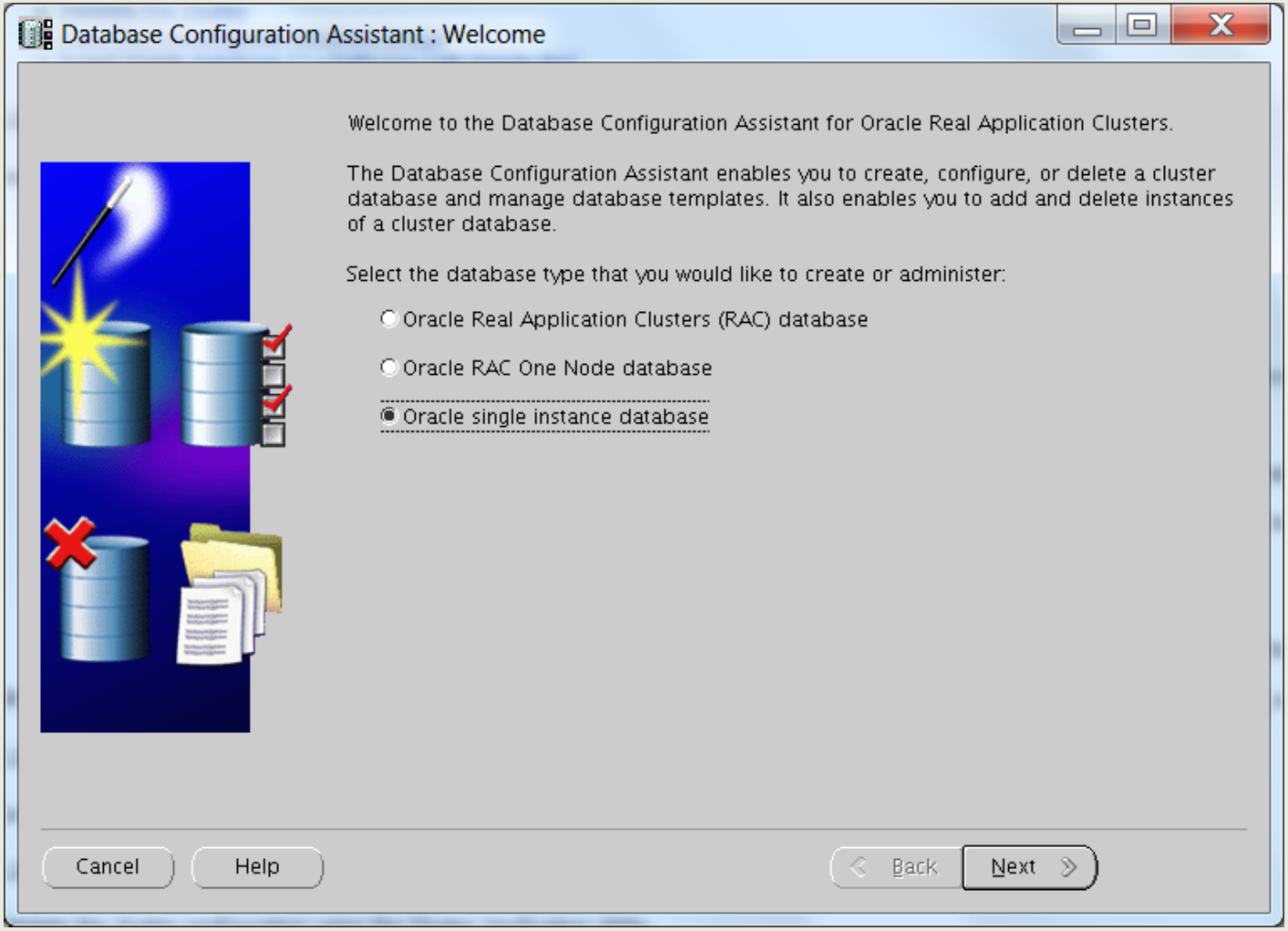
Exercise:
Create single instance databaze rconv

- Check rconv databaze status with:
  $ srvctl status database –d rconv
  you should get an information that rconv database is running
- Check rconv databaze configuration with:
  $ srvctl config database –d rconv

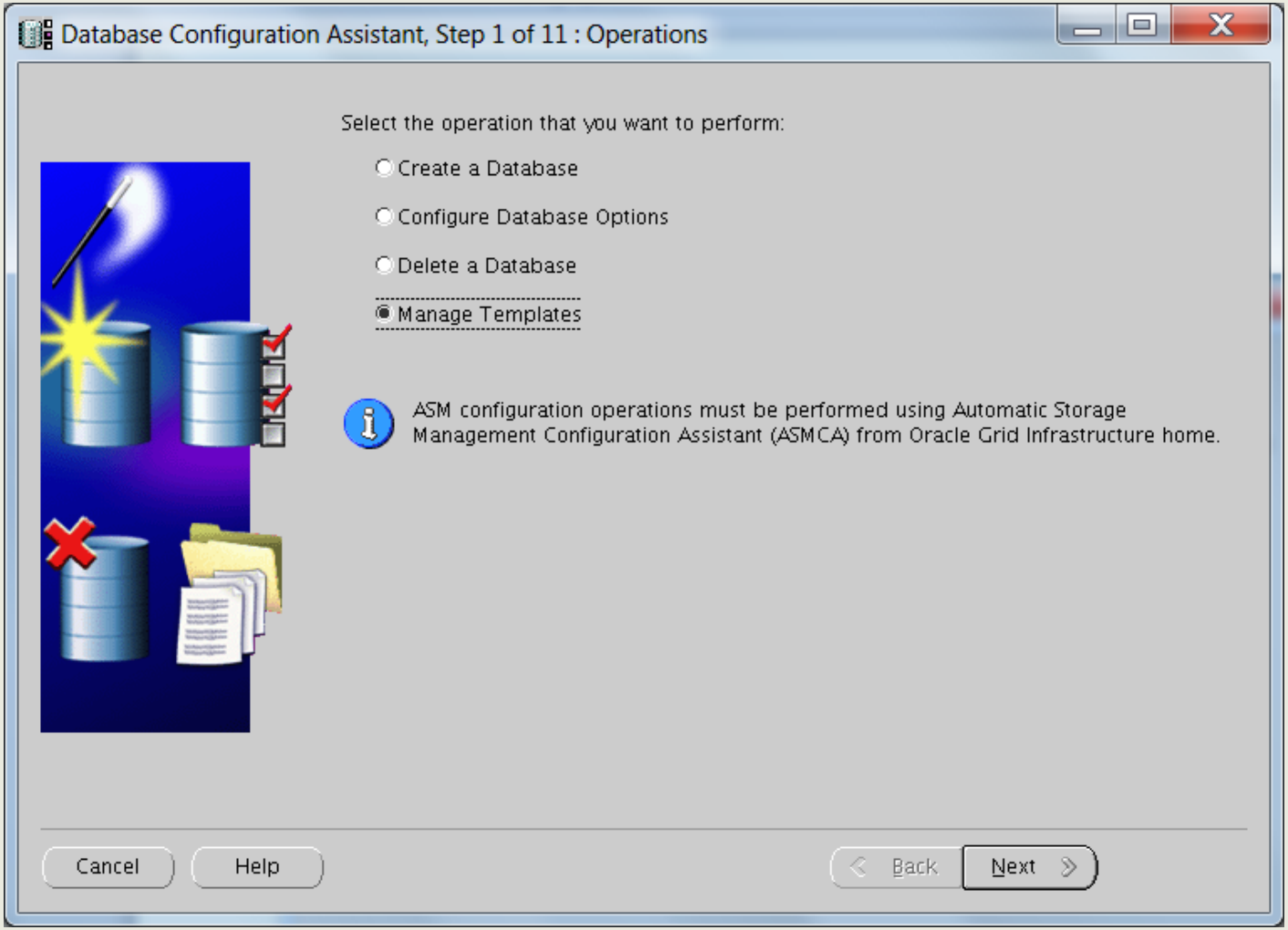
Exercise:
Create dbca template rconv database

- Prerequisites:
  - Single node database rconv is created on server rac11gtst1
  - rconv database is up and running
- Perform the following actions
  - Connect to server rac11gtst1 as user oracle
  - Run commands
    $. rconv.env
    $ dbca

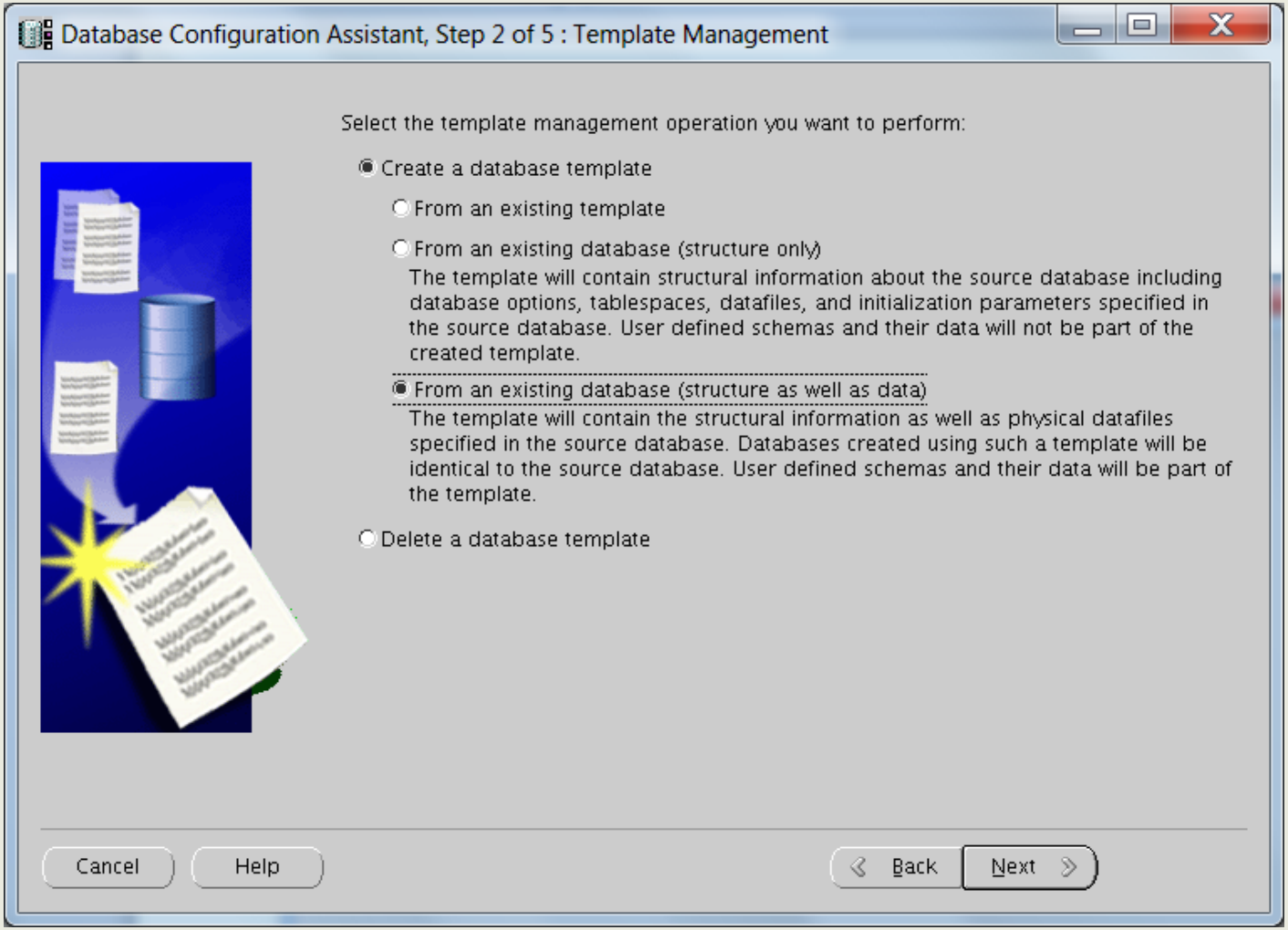
Exercise:
Create dbca template rconv database



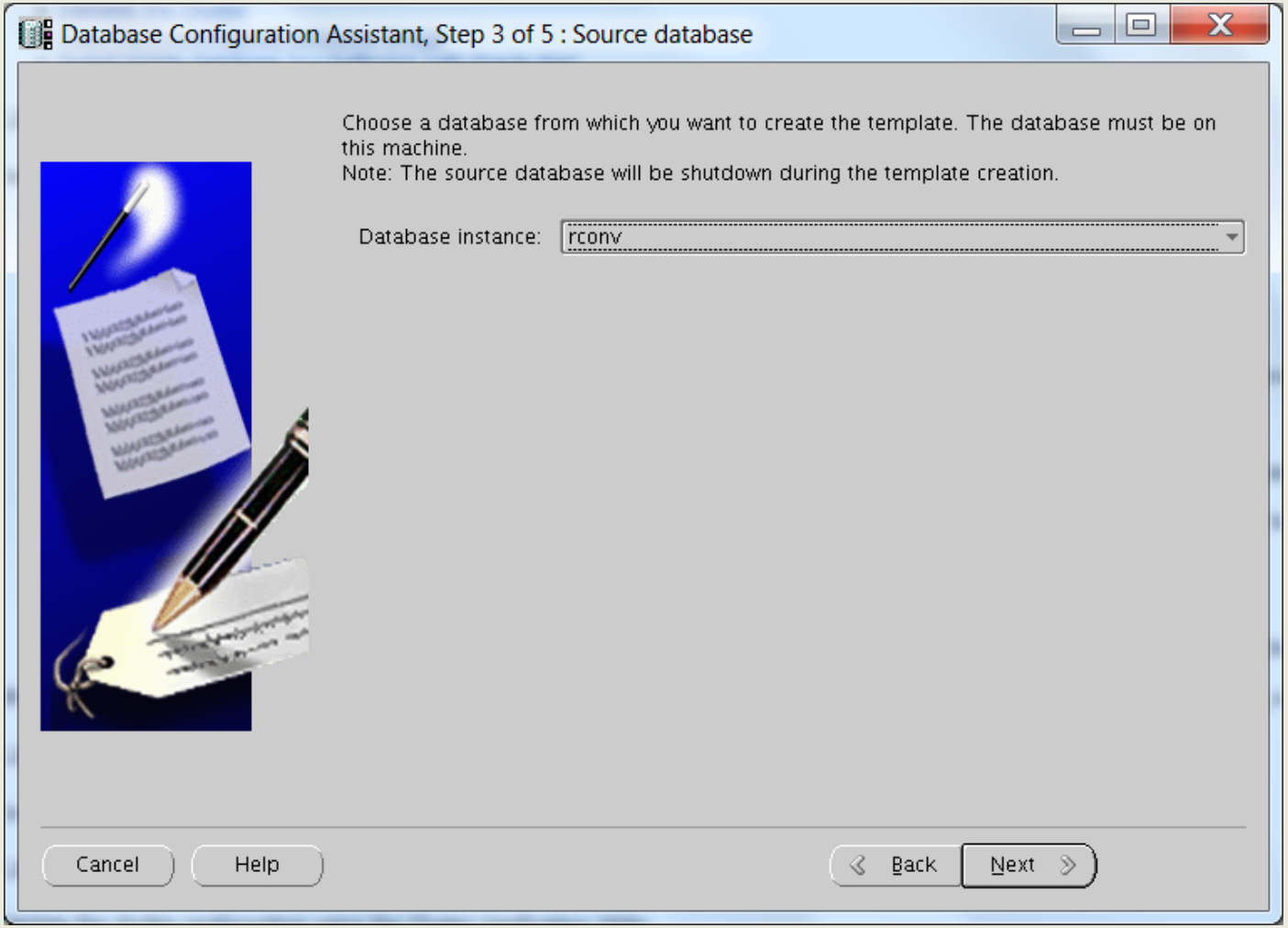
Exercise:
Create dbca template rconv database



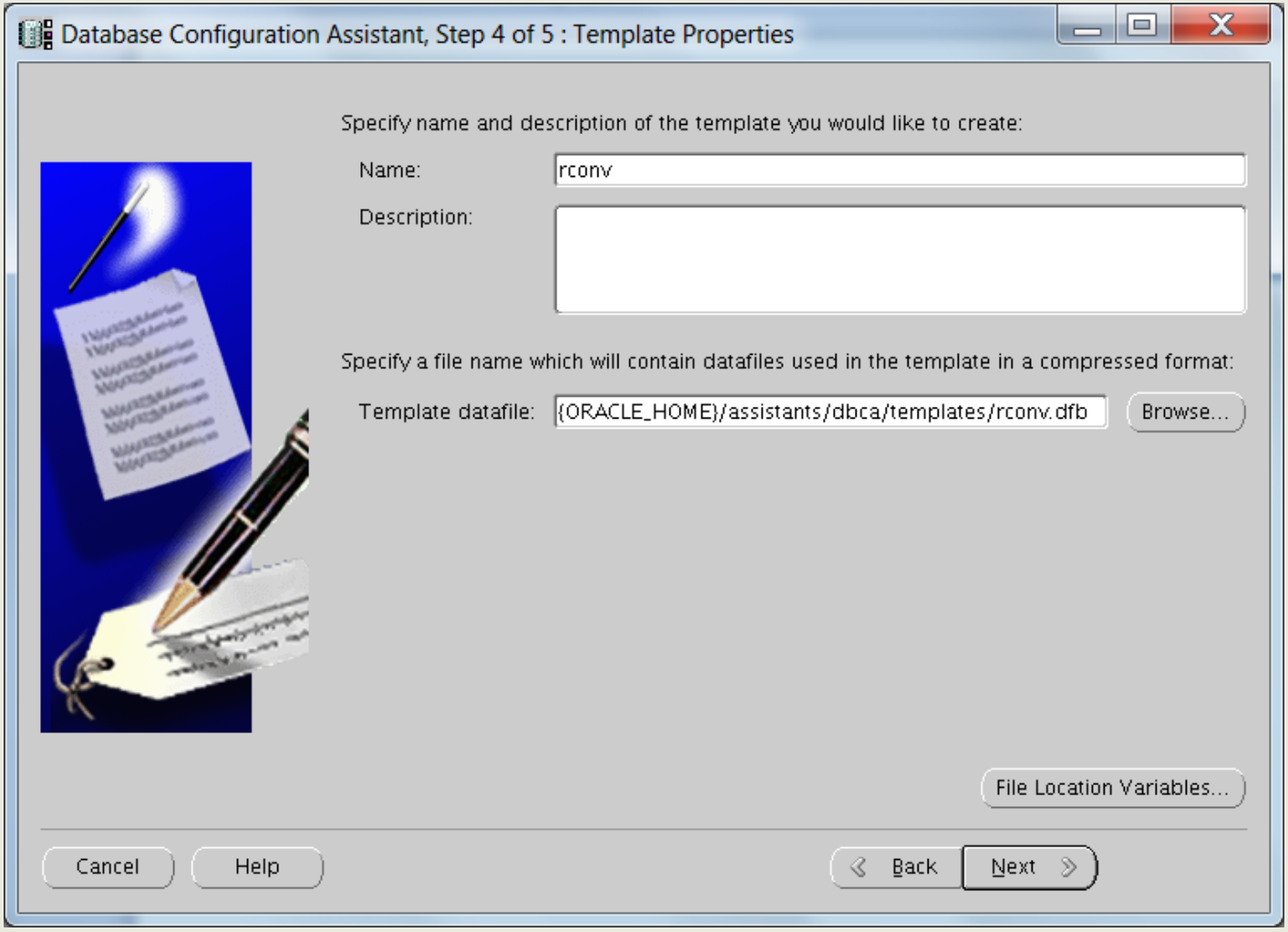
Exercise:
Create dbca template rconv database



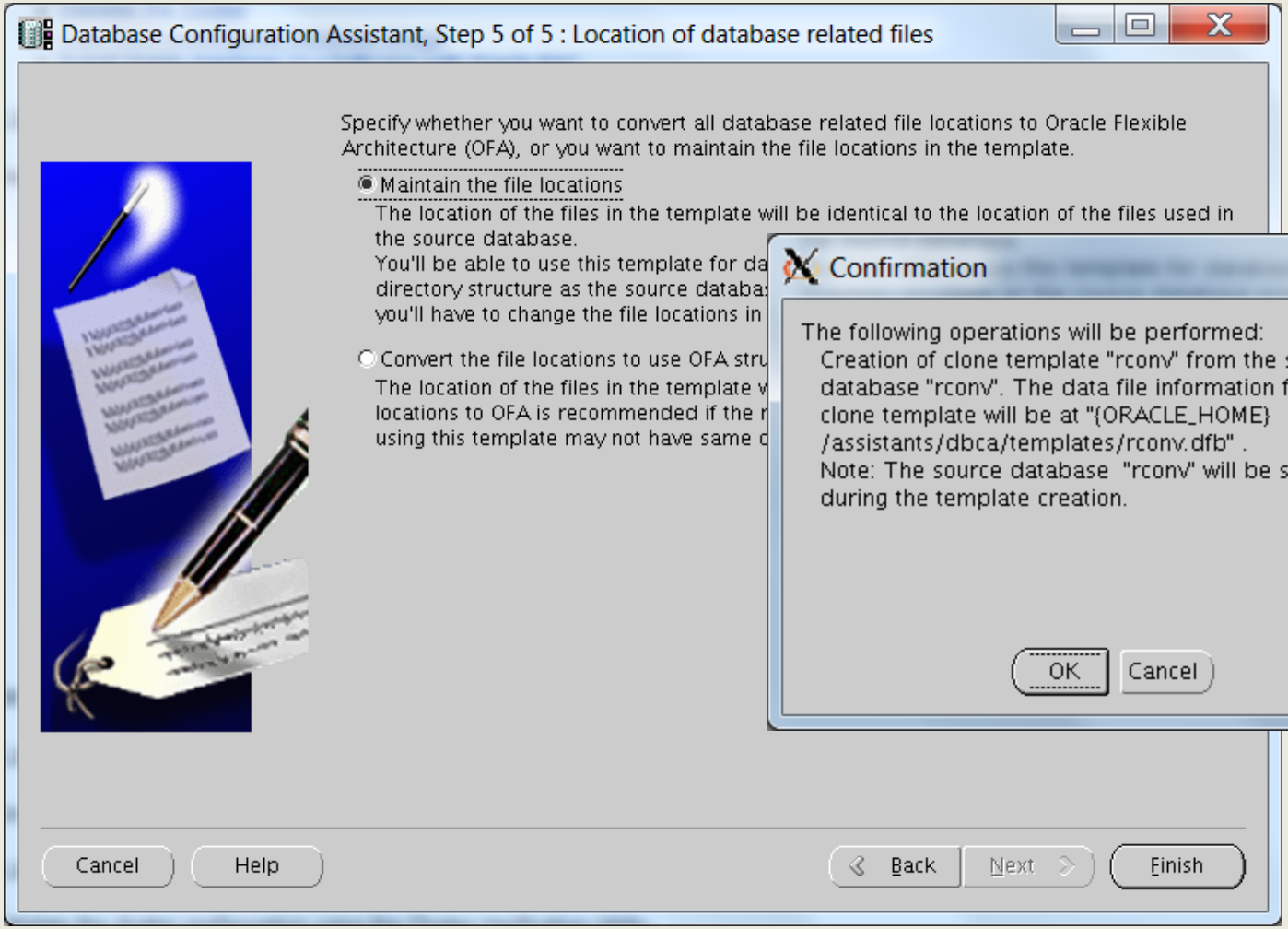
Exercise:
Create dbca template rconv database



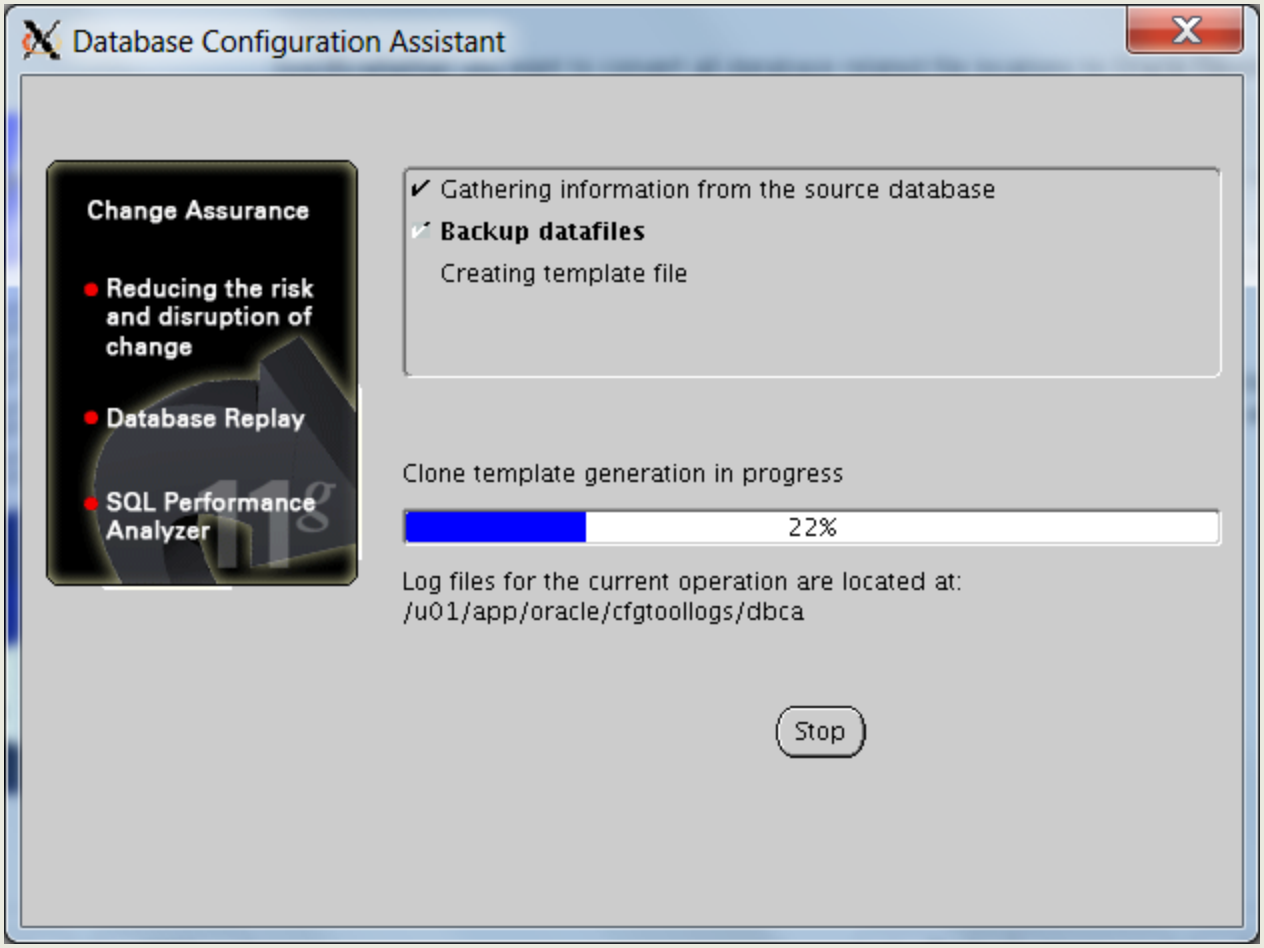
Exercise:
Create dbca template rconv database



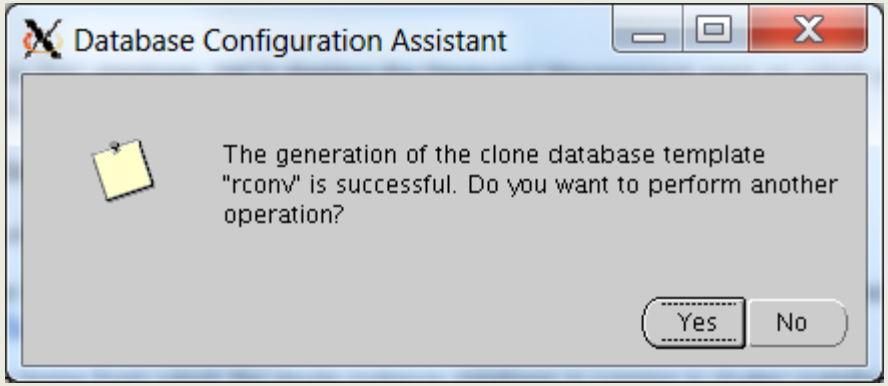
Exercise:
Create dbca template rconv database



Exercise:
Create dbca template rconv database



Exercise:
Create dbca template rconv database



Click No to continue

Exercise:
Create dbca template rconv database

- Check your template with
  $ cd $ORACLE_HOME
  $ cd assistants/dbca/templates/
  $ ls –l rconv.*
  -rw-r----- 1 oracle asmadmin 9748480 Sep 22 05:14 rconv.ctl
  -rw-r----- 1 oracle oinstall 4916 Sep 22 05:15 rconv.dbc
  -rw-r----- 1 oracle asmadmin 281985024 Sep 22 05:14 rconv.dfb

Exercise: Convert single node databaze rconv to RAC with rconfig

- Prerequisites:
  - Single node database rconv is created on server rac11gtst1
  - rconv database is up and running
- Perform the following actions
  - Connect to server rac11gtst1 as user oracle
  - Run command
    $ cd $ORACLE_HOME/assistants/rconfig/sampleXMLs
  - edit ConvertToRAC_AdminManaged.xml file with information about our Oracle installation and database that we want to convert

Exercise:
Convert single node databaze rconv to RAC with rconfig

- <n:Convert verify="ONLY">
- First time we will runrconfig with verify=„ONLY” to check that conversion prerequisites are fulfilled
- If above check is sucessfull then we will set <n:Convert verify=„YES"> and run conversion with rconfig

Exercise:
Convert single node databaze rconv to RAC with rconfig


```
<n:SourceDBHome>/u01/app/oracle/product/11.2.0/db_1
</n:SourceDBHome>
<n:TargetDBHome>/u01/app/oracle/product/11.2.0/db_1
</n:TargetDBHome>
<n:SourceDBInfo SID="rconv">
        <n:Credentials>
          <n:User>sys</n:User>
          <n:Password>ractst1</n:Password>
          <n:Role>sysdba</n:Role>
        </n:Credentials>
      </n:SourceDBInfo>
```

Exercise:
Convert single node databaze rconv to RAC with rconfig


```
<n:NodeList>
            <n:Node name="rac11gtst1"/>
            <n:Node name="rac11gtst2"/>
          </n:NodeList>
<n:InstancePrefix>rconv</n:InstancePrefix>
<n:SharedStorage type="ASM">
<n:TargetDatabaseArea>+ORADATA2</n:TargetDatabaseArea>
<n:TargetFlashRecoveryArea>+ORAFLASH</n:TargetFlashRecoveryArea>
```

Exercise:
Convert single node databaze rconv to RAC with rconfig

$ rconfig ConvertToRAC_rconv.xml (sa opcijom verify=ONLY)

```
<?xml version="1.0" ?>
<RConfig version="1.1" >
<ConvertToRAC>
    <Convert>
      <Response>
        <Result code="0" >
          Operation Succeeded
        </Result>
      </Response>
      <ReturnValue type="object">
There is no return value for this step     </ReturnValue>
    </Convert>
  </ConvertToRAC></RConfig>
```

Exercise:
Convert single node databaze rconv to RAC with rconfig


```
$ rconfig ConvertToRAC_rconv.xml (sa opcijom verify=YES)
Converting Database "rconv" to Cluster Database. Target Oracle Home: /u01/app/oracle/product/11.2.0/db_1.
Database Role: PRIMARY.
Setting Data Files and Control Files
Adding Database Instances
Adding Redo Logs
Enabling threads for all Database Instances
Setting TEMP tablespace
Adding UNDO tablespaces
Adding Trace files
Setting Fast Recovery Area
Updating Oratab
Creating Password file(s)
Configuring Listeners
Configuring related CRS resources
Starting Cluster Database
<?xml version="1.0" ?>
<RConfig version="1.1" >
<ConvertToRAC>
   <Convert>
     <Response>
       <Result code="0" >
         Operation Succeeded
       </Result>
     </Response>
     <ReturnValue type="object">
```

Exercise:
Convert single node databaze rconv to RAC with rconfig


```
<Oracle_Home>
      /u01/app/oracle/product/11.2.0/db_1
    </Oracle_Home>
    <Database type="ADMIN_MANAGED"  >
     <InstanceList>
       <Instance SID="rconv1" Node="rac11gtst1"  >
       </Instance>
       <Instance SID="rconv2" Node="rac11gtst2"  >
       </Instance>
     </InstanceList>
    </Database>    </ReturnValue>
  </Convert>
</ConvertToRAC></RConfig>
```

Exercise:
Convert single node databaze rconv to RAC with rconfig

- If single instance database conversion to RAC database was sucessfull you can check database status with:
  $ srvctl status database –d rconv
  Instance rconv1 is running on node rac11gtst1
  Instance rconv2 is running on node rac11gtst2
  as a result you should get an information that rconv database instances are running on servers rac11gtst1 and rac11gtst2
  $ srvctl config database –d rconv
  among other information you should also get that
  Type: RAC

Exercise:
Convert single node databaze rconv to RAC with rconfig

- For RAC rconv database it is necessary to convert Enterprise Manager repositroy to cluster format using the following procedure:
  - Connect to server rac11gtst1 as user oracle
  - Run command
    $. rconv.env

Exercise:
Convert single node databaze rconv to RAC with rconfig

$ emca -config dbcontrol db -repos recreate -cluster
STARTED EMCA at Sep 24, 2011 6:41:30 AM
EM Configuration Assistant, Version 11.2.0.0.2 Production
Copyright (c) 2003, 2005, Oracle. All rights reserved.
Enter the following information:
Database unique name: **rconv**
Service name: **rconv**
Listener ORACLE_HOME [/u01/11.2.0/grid]:
Password for SYS user:
Database Control is already configured for the database rconv
You have chosen to configure Database Control for managing the database rconv
This will remove the existing configuration and the default settings and perform a fresh configuration
---
WARNING : While repository is dropped the database will be put in quiesce mode.

Do you wish to continue? [yes(Y)/no(N)]: **Y**

Exercise:
Convert single node databaze rconv to RAC with rconfig

Password for DBSNMP user:
Password for SYSMAN user:
Cluster name: rac11gr2tst
Email address for notifications (optional):
Outgoing Mail (SMTP) server for notifications (optional):
ASM ORACLE_HOME [/u01/11.2.0/grid]:
ASM port [1521]:
ASM username [ASMSNMP]:
ASM user password:

Exercise:
Convert single node databaze rconv to RAC with rconfig

You have specified the following settings

Database ORACLE_HOME ..... /u01/app/oracle/product/11.2.0/db_1

Database instance hostname ..... Listener ORACLE_HOME ..... /u01/11.2.0/grid
Listener port number 1521
Cluster name rac11gr2tst
Database unique name ..... rconv
Email address for notifications .....
Outgoing Mail (SMTP) server for notifications .....
ASM ORACLE_HOME ..... /u01/11.2.0/grid
ASM port 1521
ASM user role ..... SYSDBA
ASM username ..... ASMSNMP

WARNING : While repository is dropped the database will be put in quiesce mode.

Do you wish to continue? [yes(Y)/no(N)]: **Y**

Exercise: Convert single node databaze rconv to RAC with rconfig

- If emca program finished sucessfully you will get a status:
  INFO: Database Control started successfully

```
INFO: >>>>>>>>>>> The Database Control URL is
https://rac11gtst1.tst.org:5500/em <<<<<<<<<<<
INFO:
****************  Current Configuration  ****************
INSTANCE          NODE          DBCONTROL_UPLOAD_HOST
---------         ----------    --------------------
rconv             rac11gtst1          rac11gtst1.tst.org
rconv             rac11gtst2          rac11gtst1.tst.org
Enterprise Manager configuration completed successfully
```

- You can check Enterprise Manager status with commands:

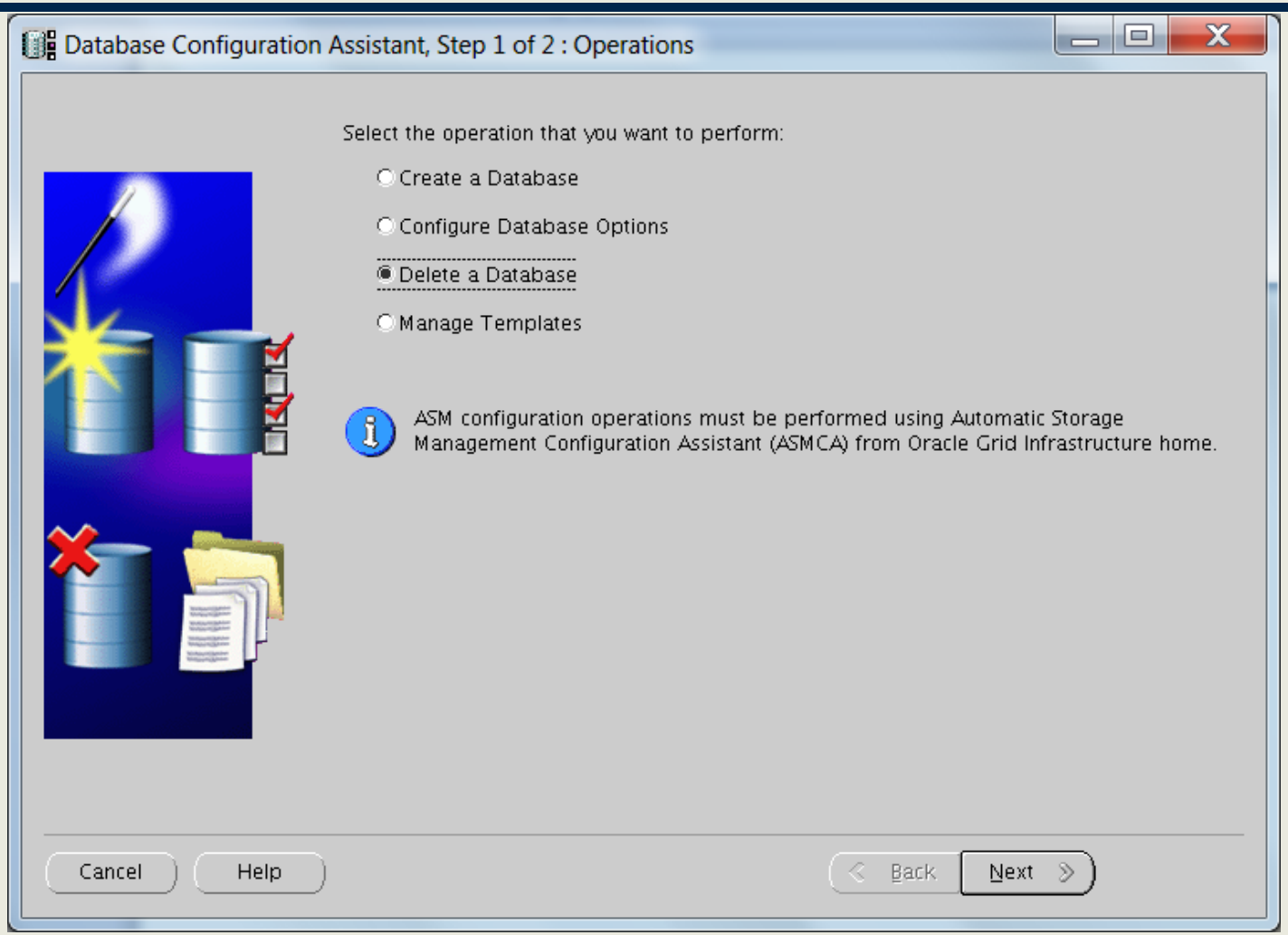
```
$ emctl status dbconsole (run on rac11gtst1 i rac11gtst2)
$ echo "Y"|emca -displayConfig dbcontrol -cluster -DB_UNIQUE_NAME
rconv -SERVICE_NAME rconv (run on rac11gtst1)
```

Exercise:
Create RAC database with dbca template for single instance database rconv

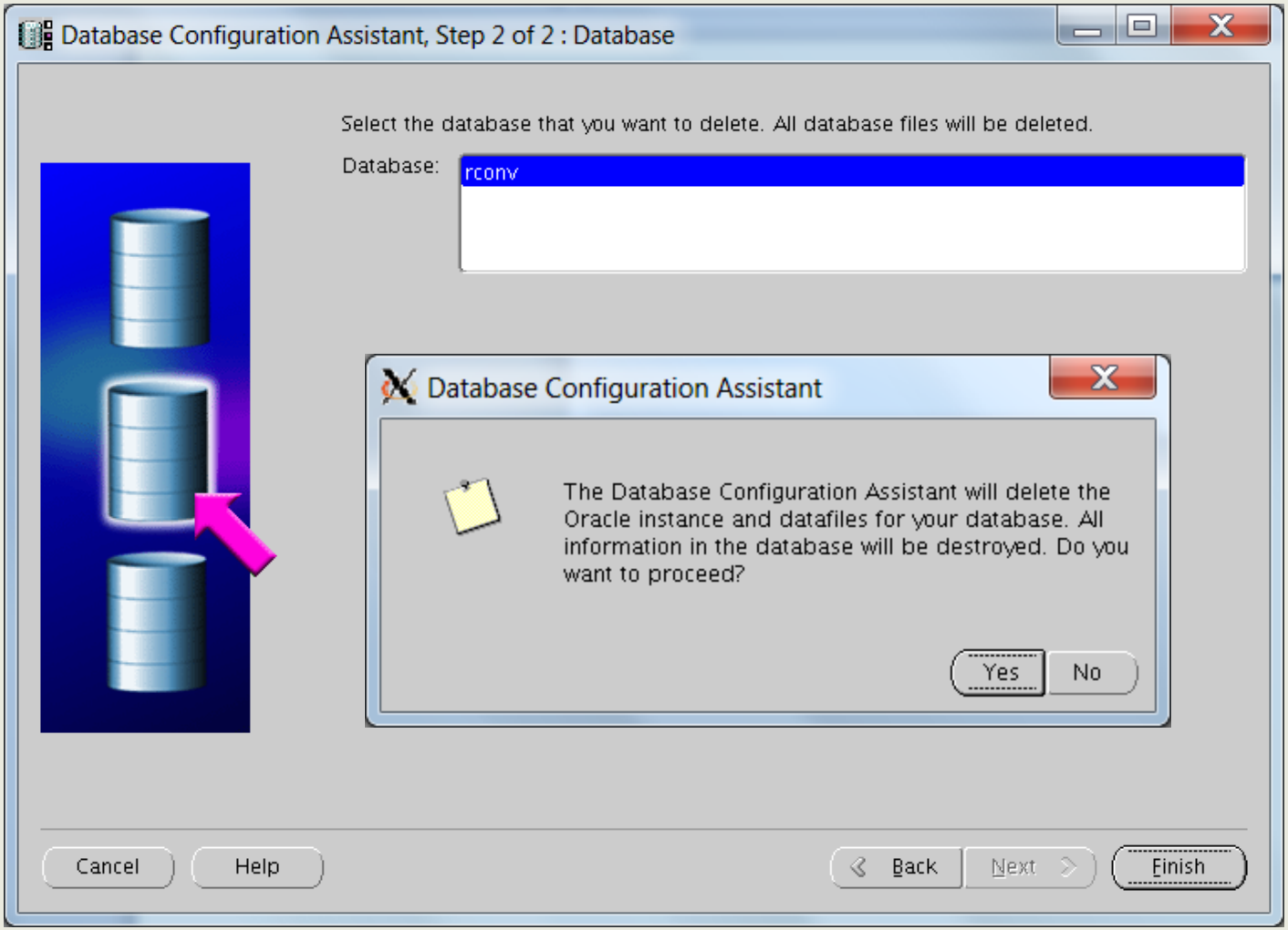
- Prerequisites:
  - Single node database rconv is created on server rac11gtst1
  - rconv database is up and running
  - dbca template rconv for single instance database rconv is created
- Perform the following actions
  - Connect to server rac11gtst1 as user oracle
  - Run commands
    $. rconv.env
    $ dbca
  - Delete single instance database rconv with dbca
  - Create RAC database rconv with dbca template rconv

Exercise:
Create RAC database with dbca template for single instance database rconv

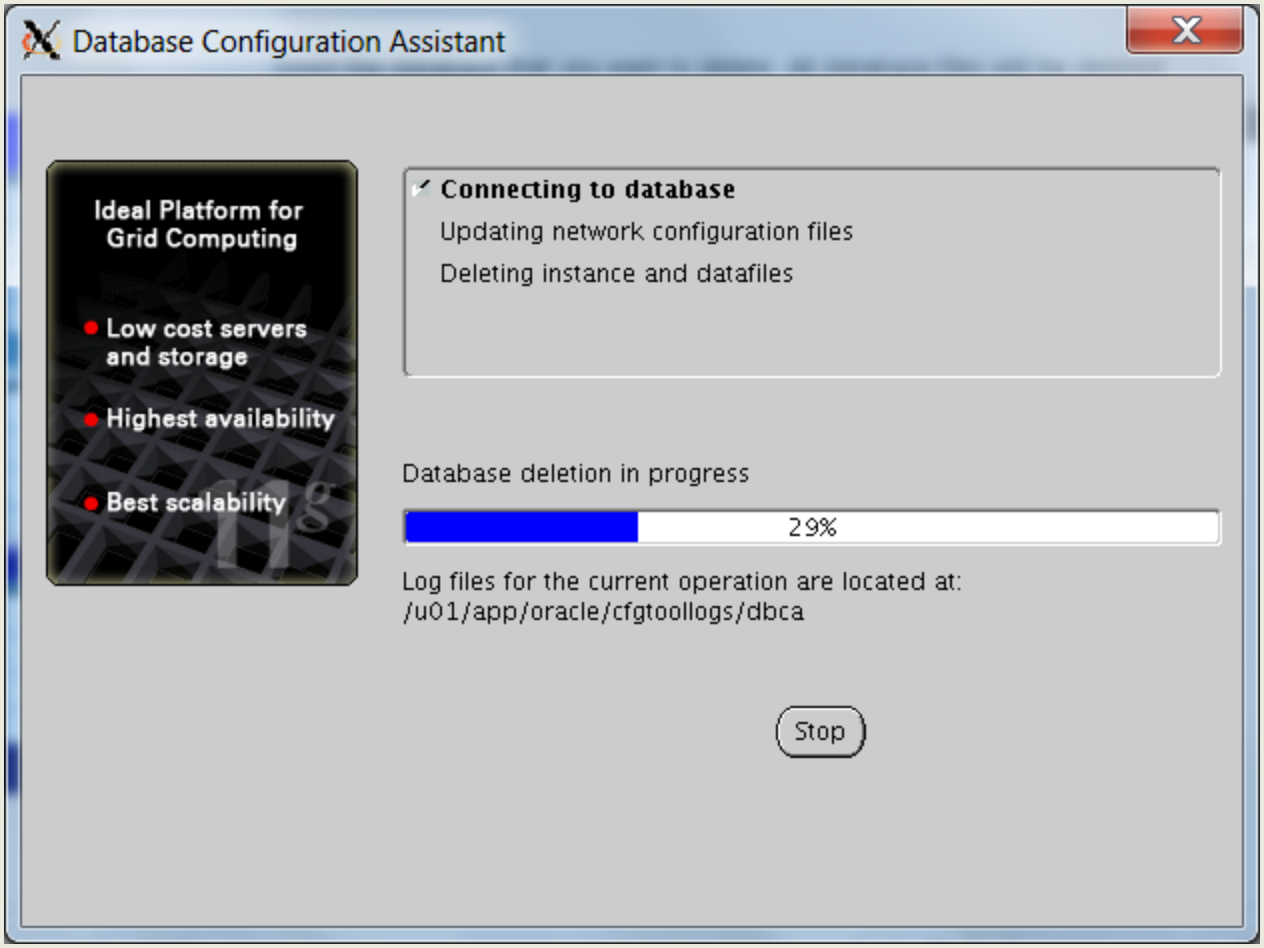
Exercise:
Create RAC database with dbca template for single instance database rconv



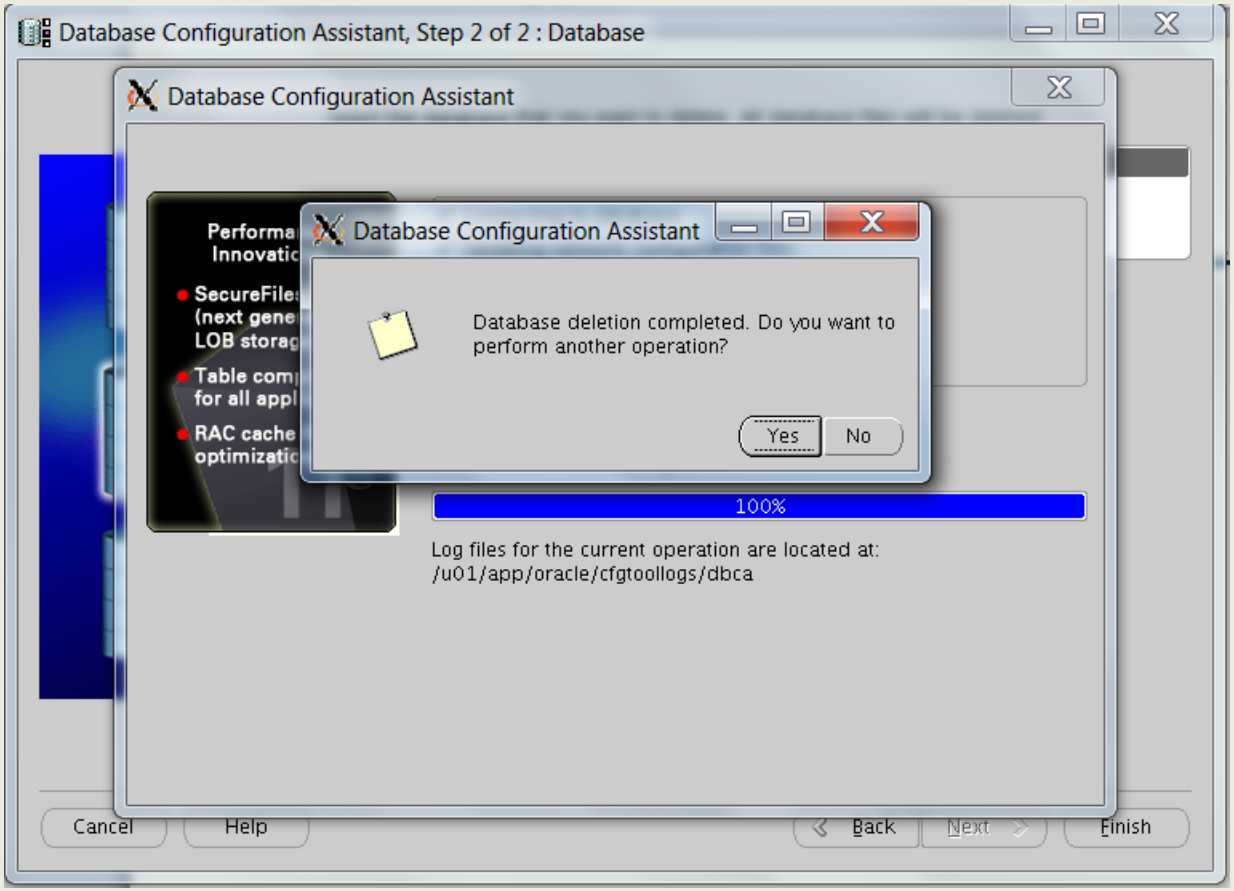
Exercise:
Create RAC database with dbca template for single instance database rconv



Exercise:
Create RAC database with dbca template for single instance database rconv



Exercise:
Create RAC database with dbca template for single instance database rconv



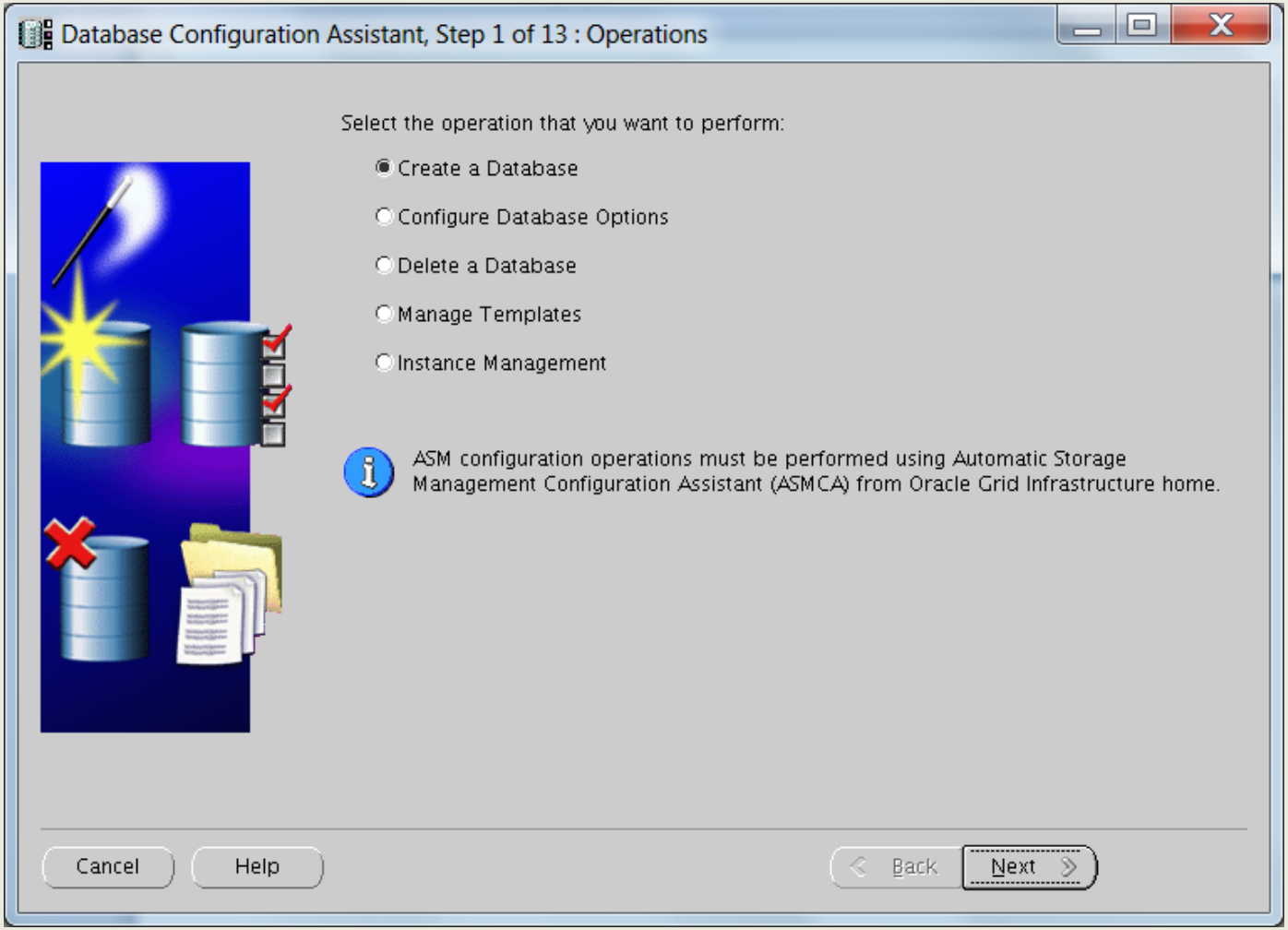
Click No to continue

Exercise:
Create RAC database with dbca template for single instance database rconv

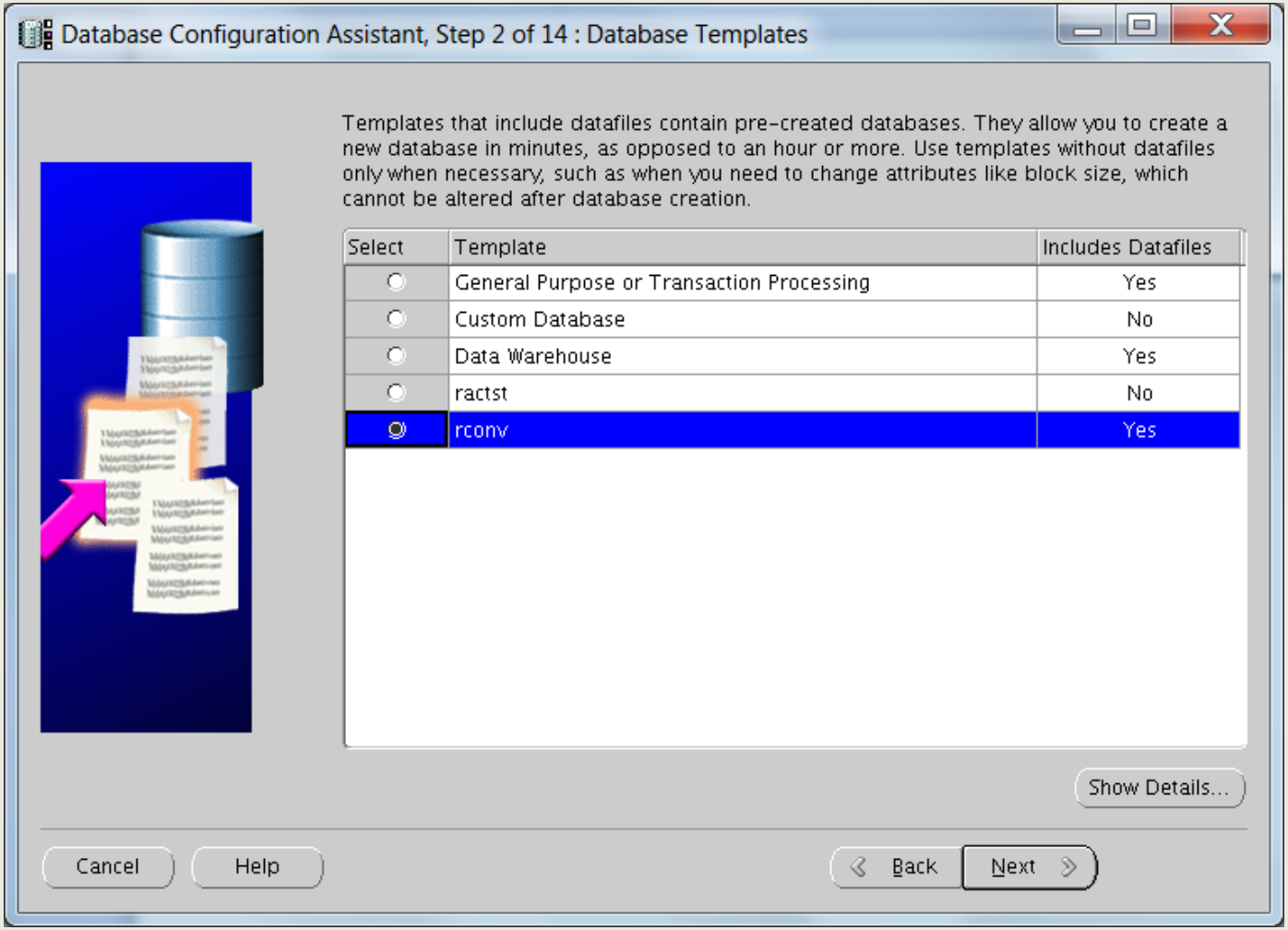
- Run dbca again and create RAC database rconv with dbca template rconv:
  $ dbca

Exercise:
Create RAC database with dbca template for single instance database rconv

Exercise:
Create RAC database with dbca template for single instance database rconv



Exercise:
Create RAC database with dbca template for single instance database rconv



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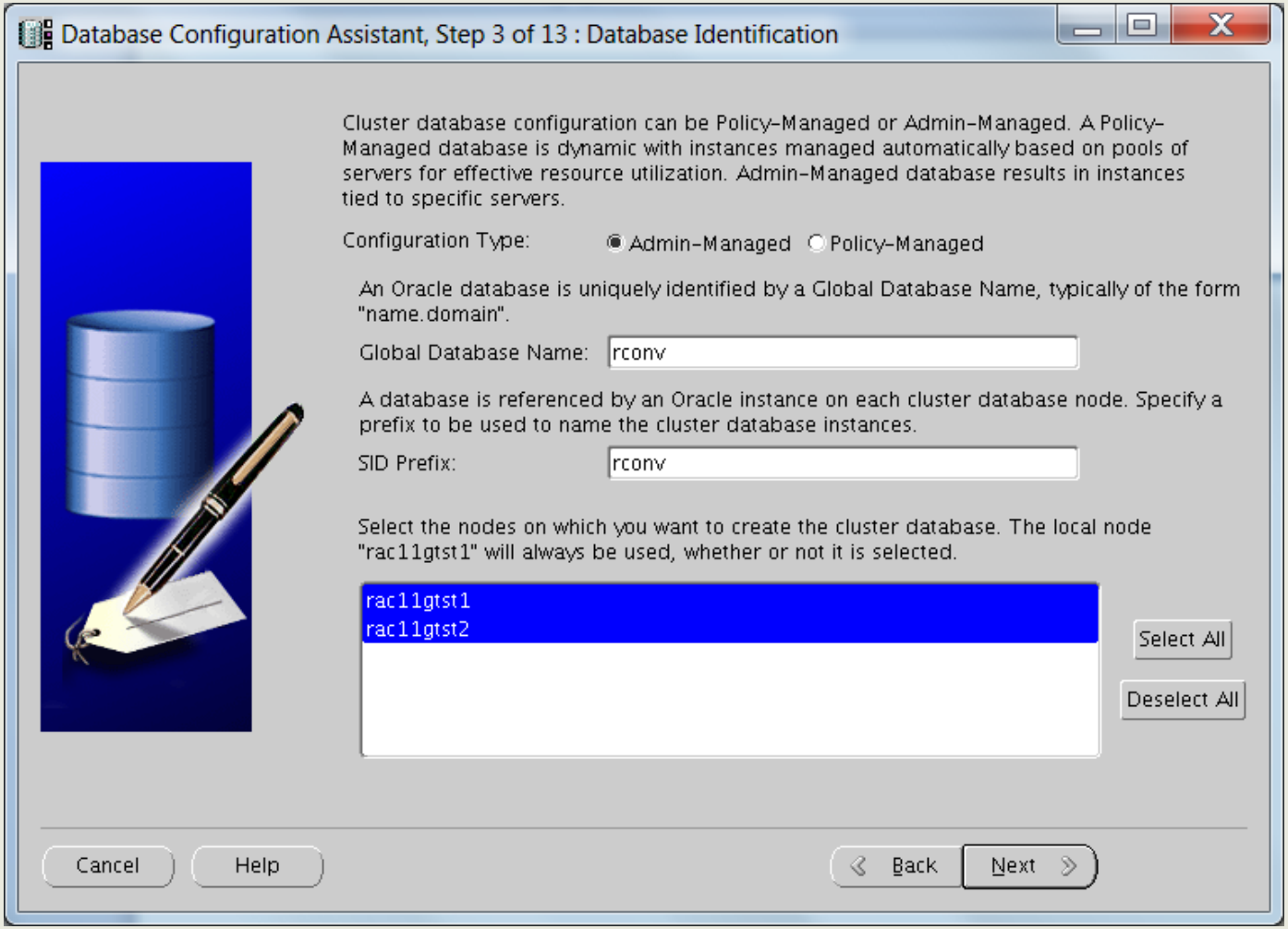
Create RAC database with dbca template for single instance database rconv



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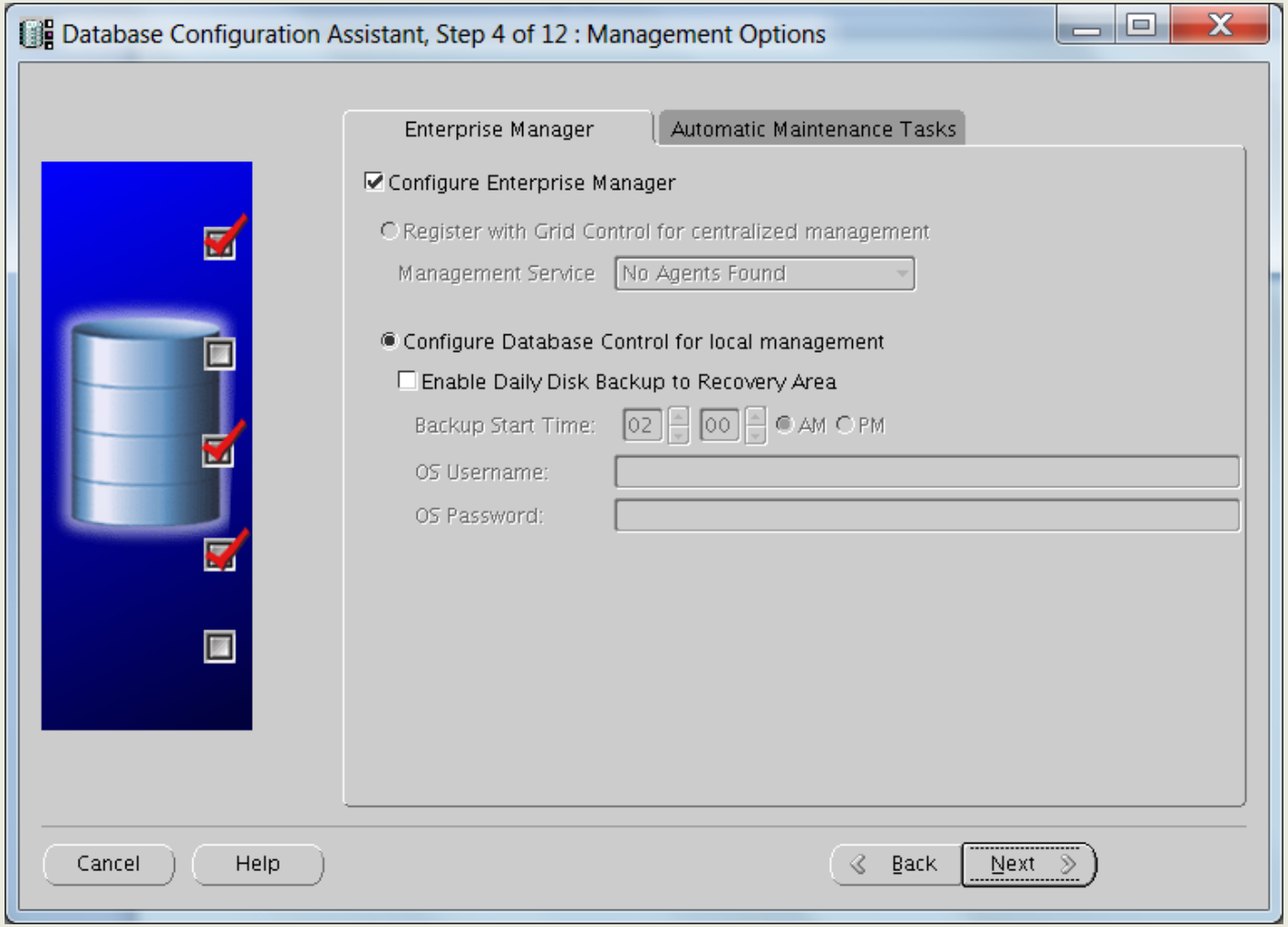
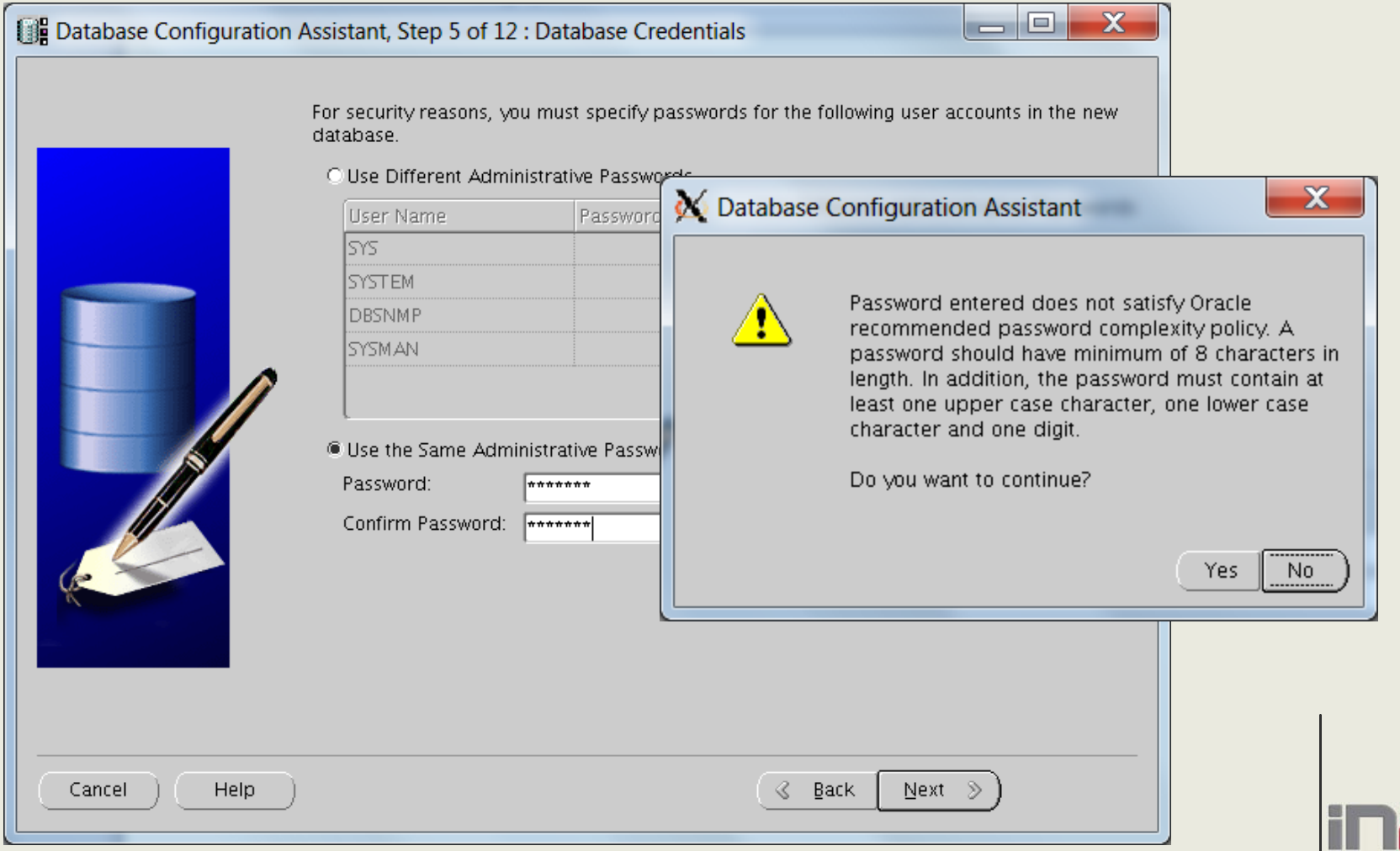
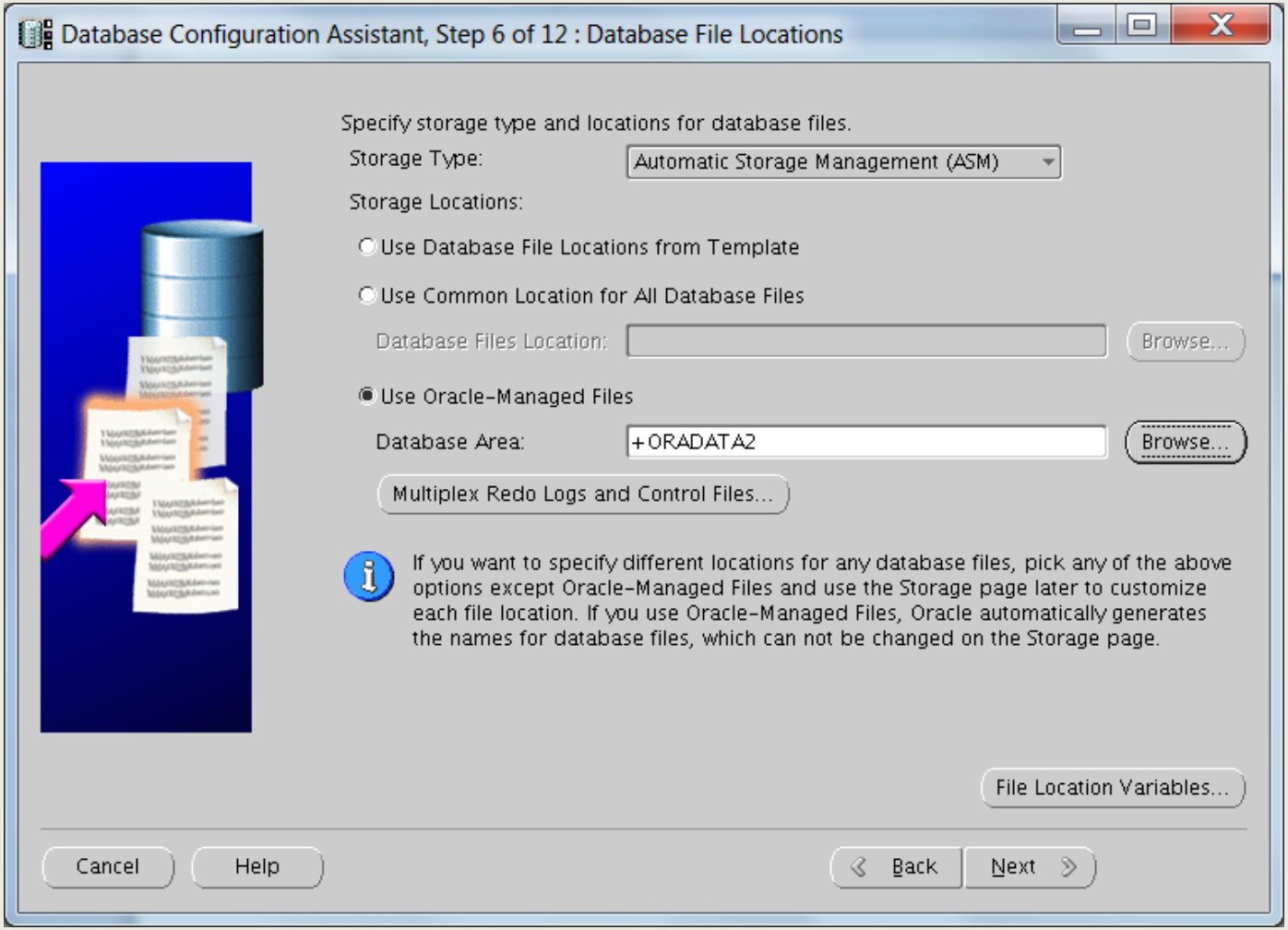


Exercise:
Create RAC database with dbca template for single instance database rconv

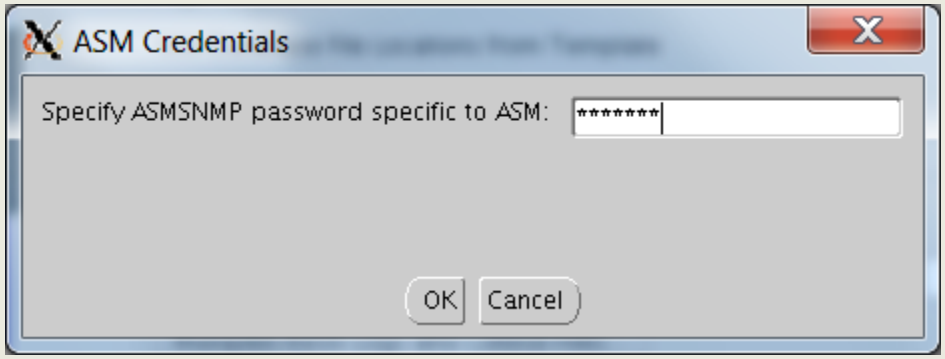


Password for all users is ractst1

Exercise:
Create RAC database with dbca template for single instance database rconv

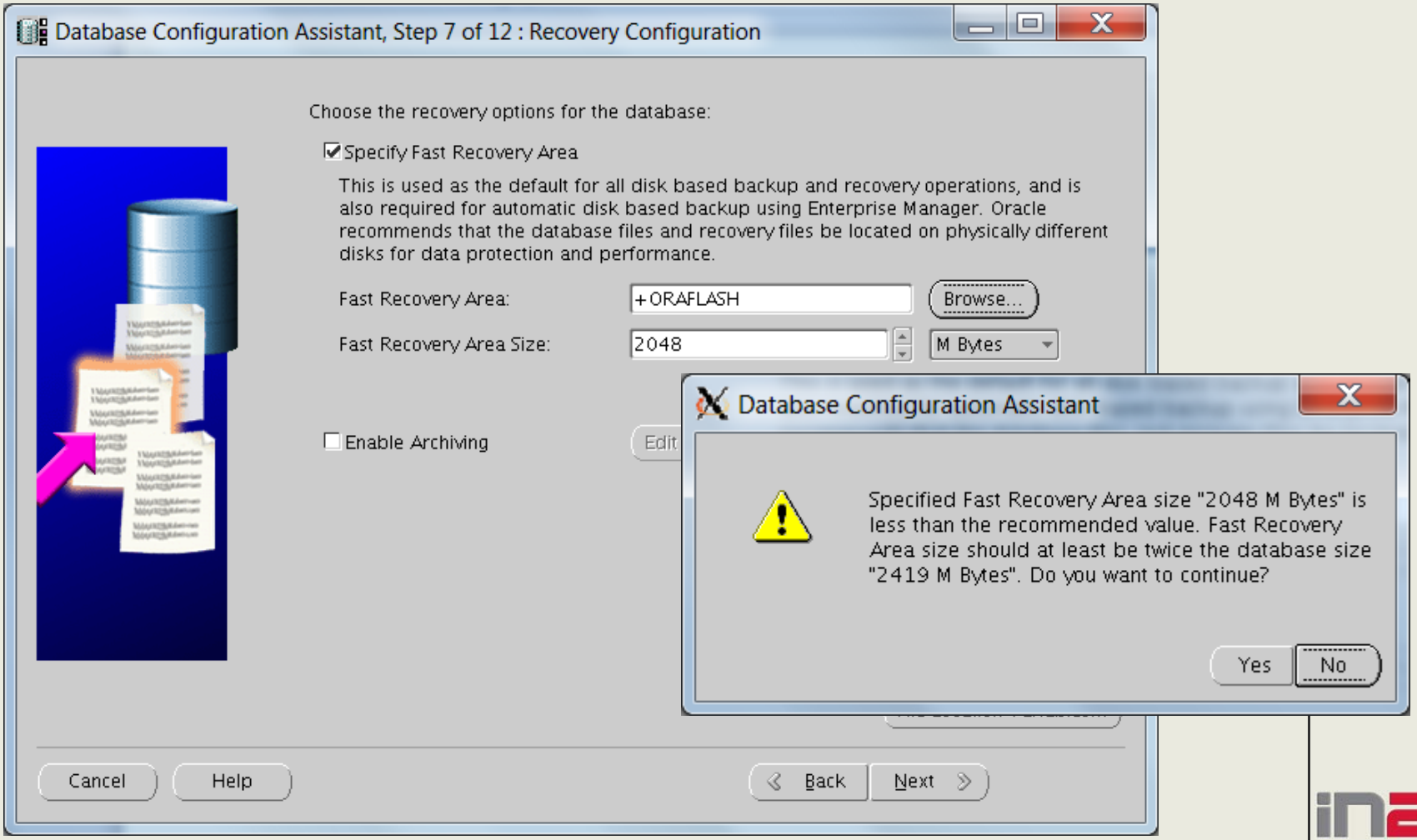


Exercise:
Create RAC database with dbca template for single instance database rconv

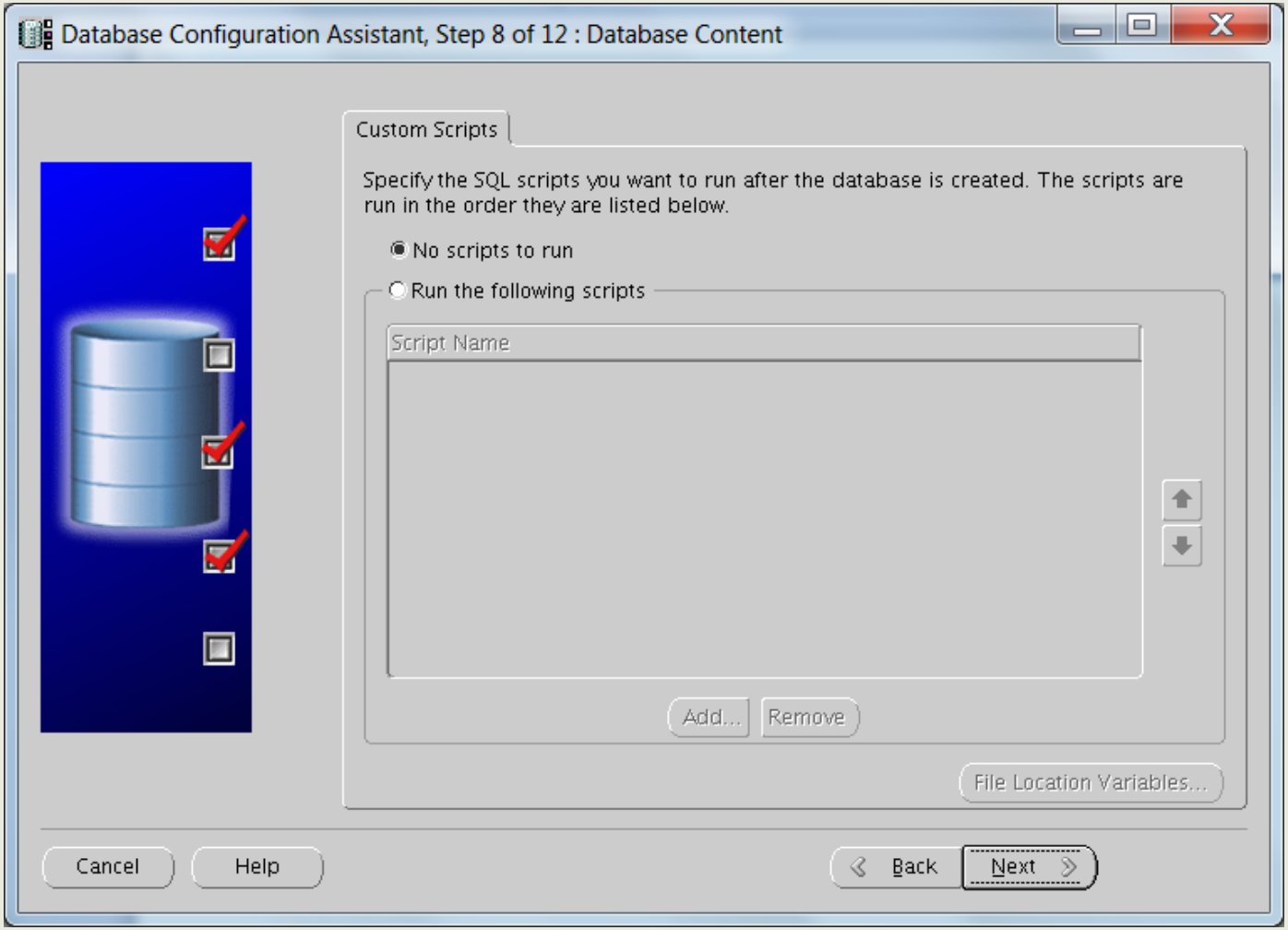


Password is ractst1

Exercise:
Create RAC database with dbca template for single instance database rconv



Exercise:
Create RAC database with dbca template for single instance database rconv



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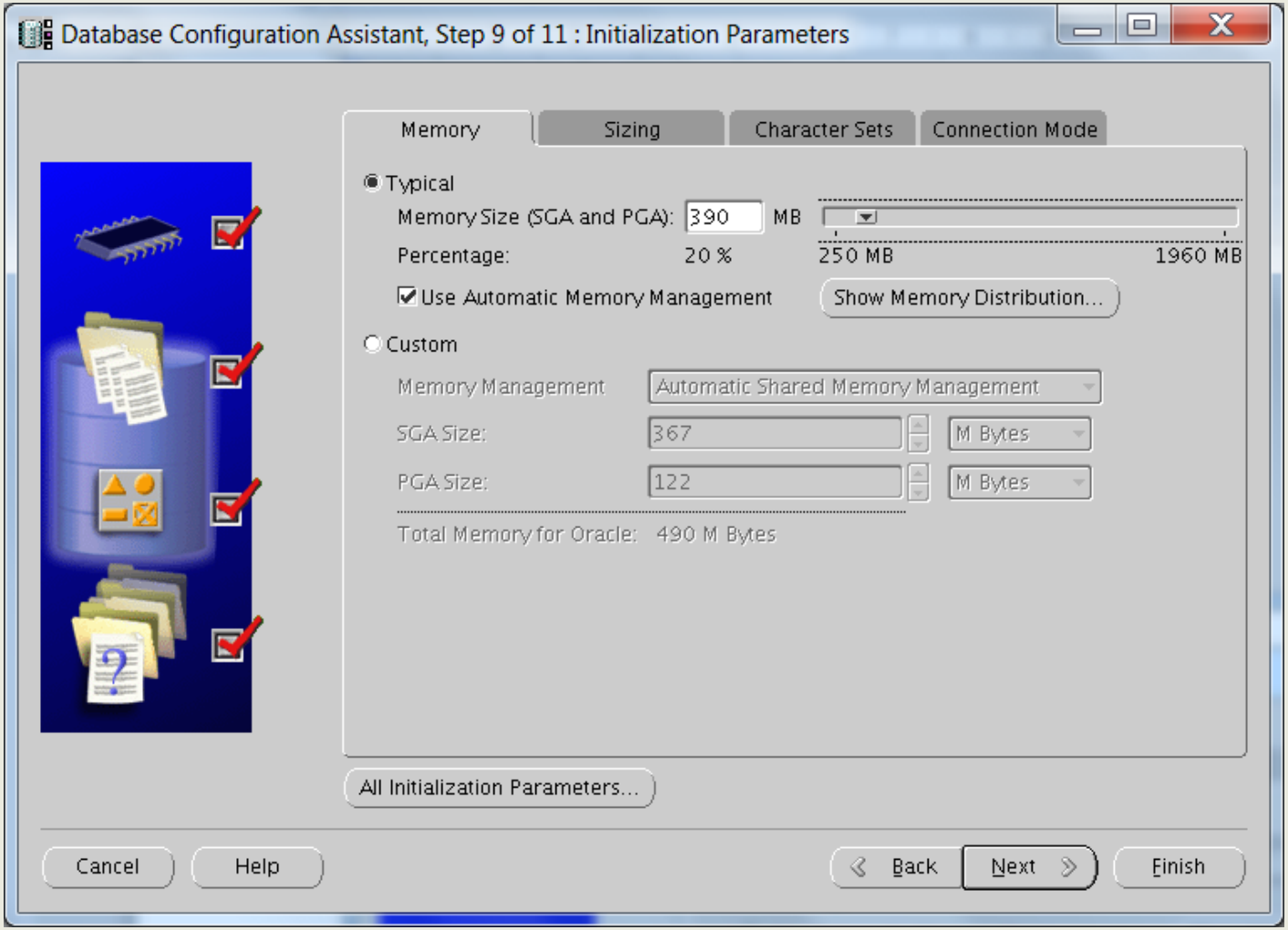
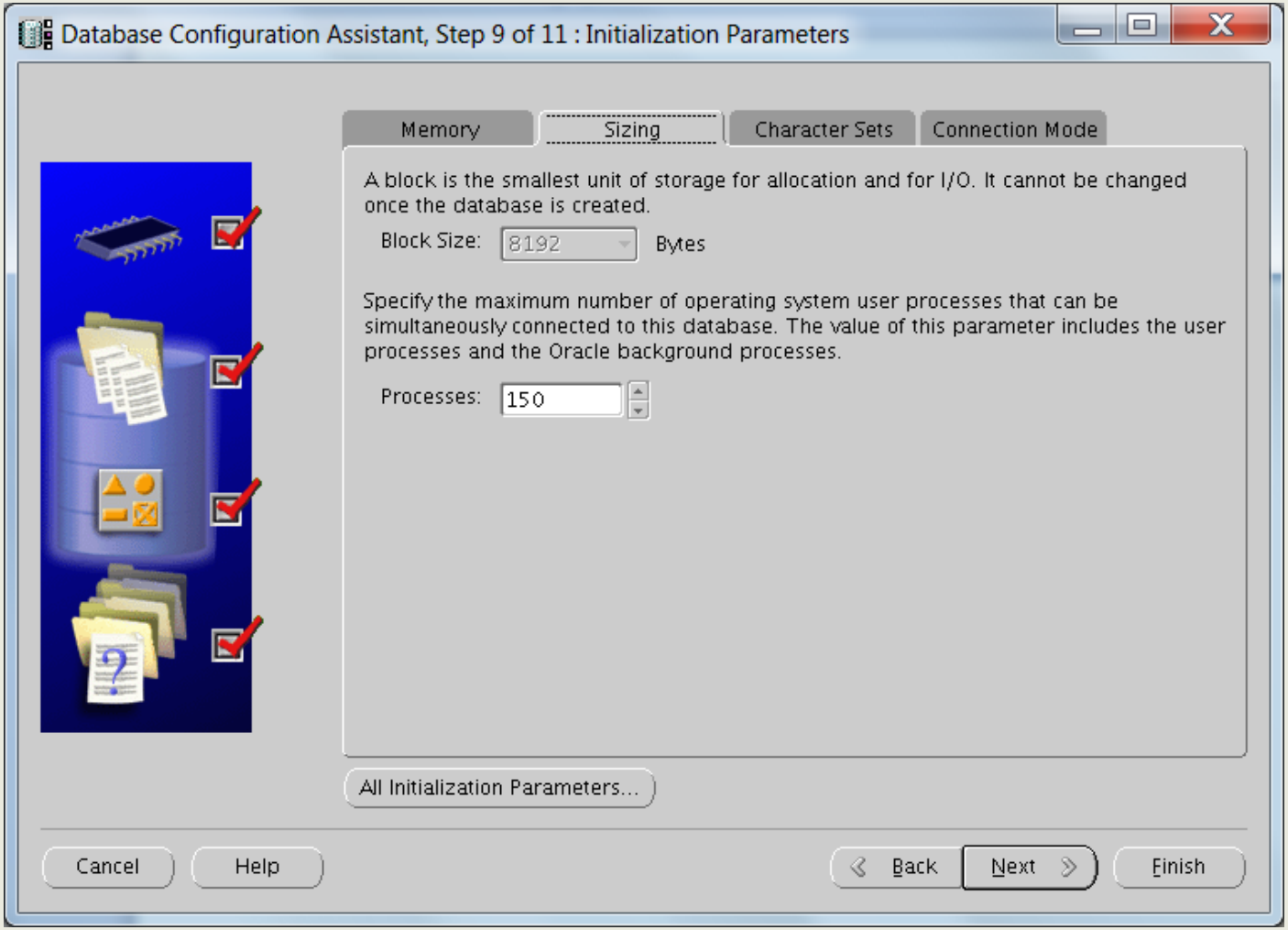
Create RAC database with dbca template for single instance database rconv



Exercise:
Create RAC database with dbca template for single instance database rconv



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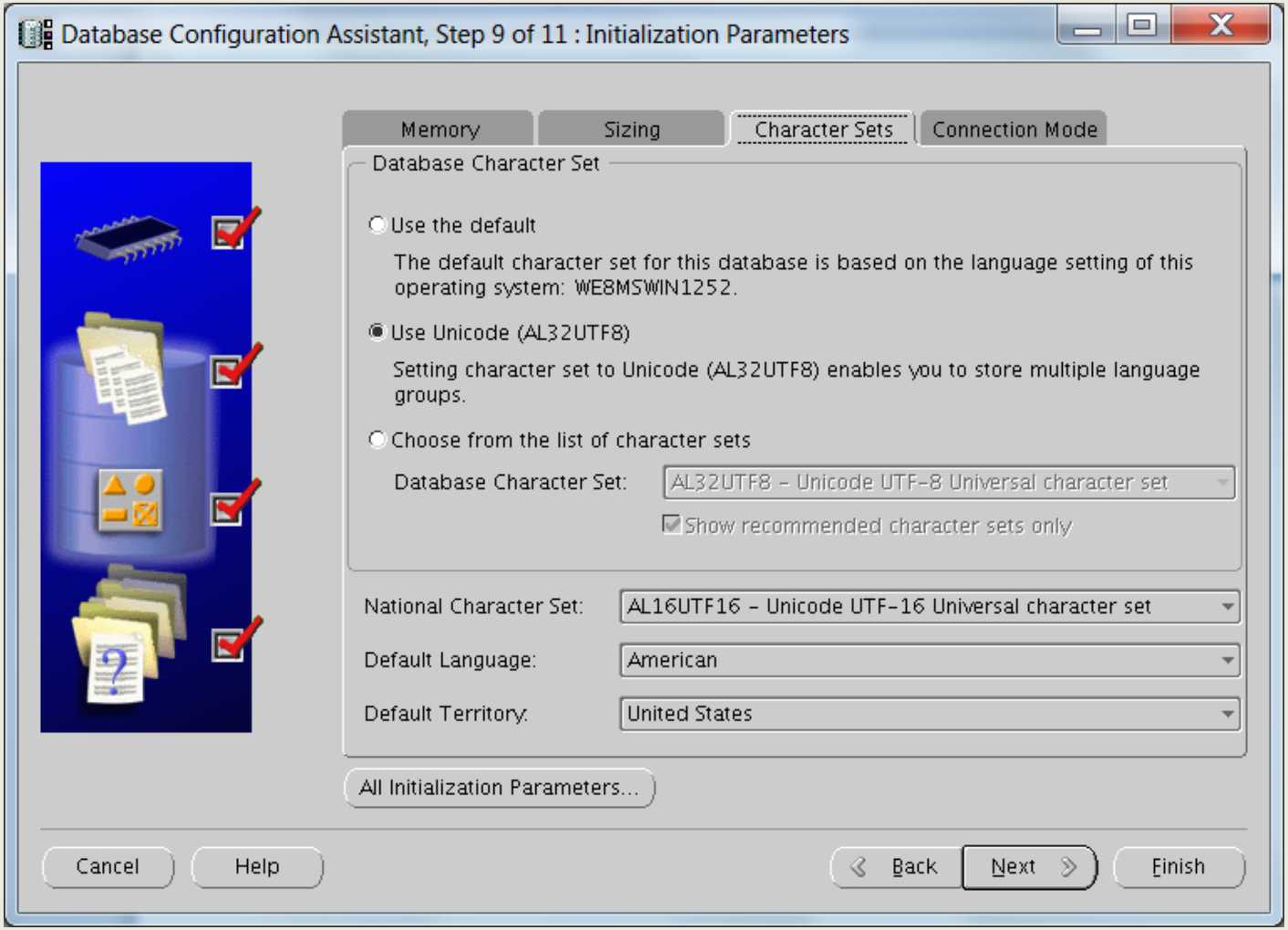
Create RAC database with dbca template for single instance database rconv



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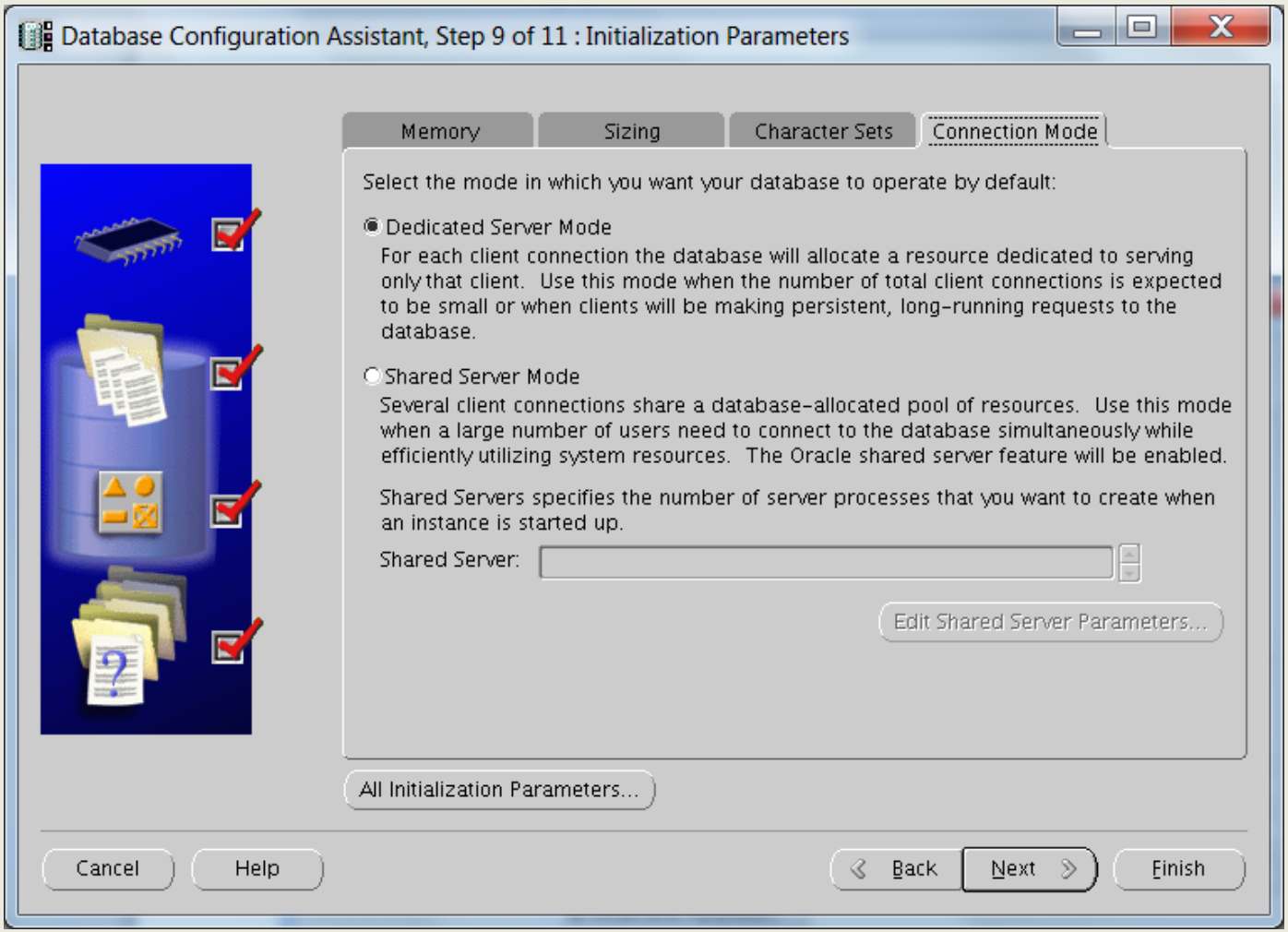
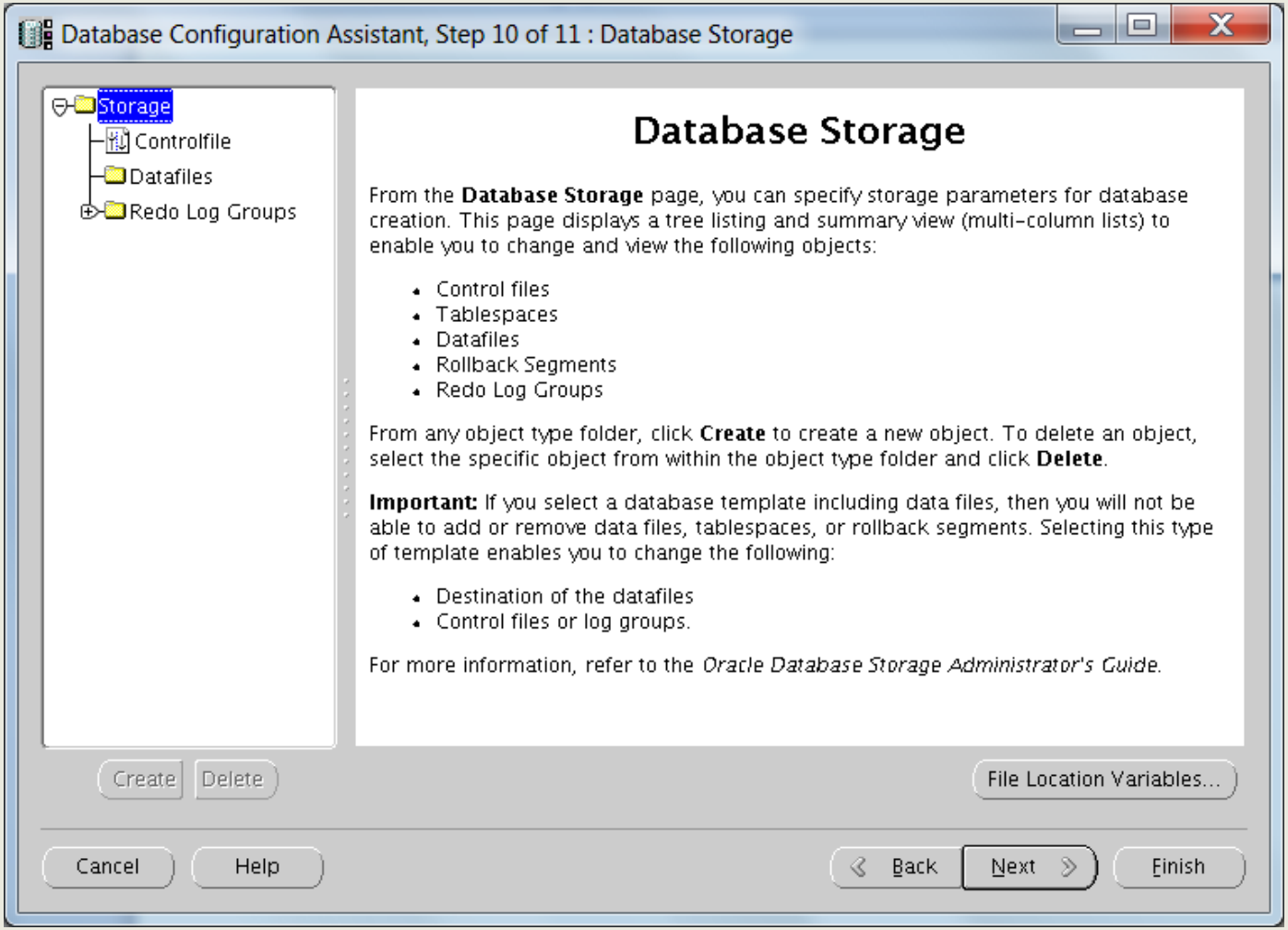
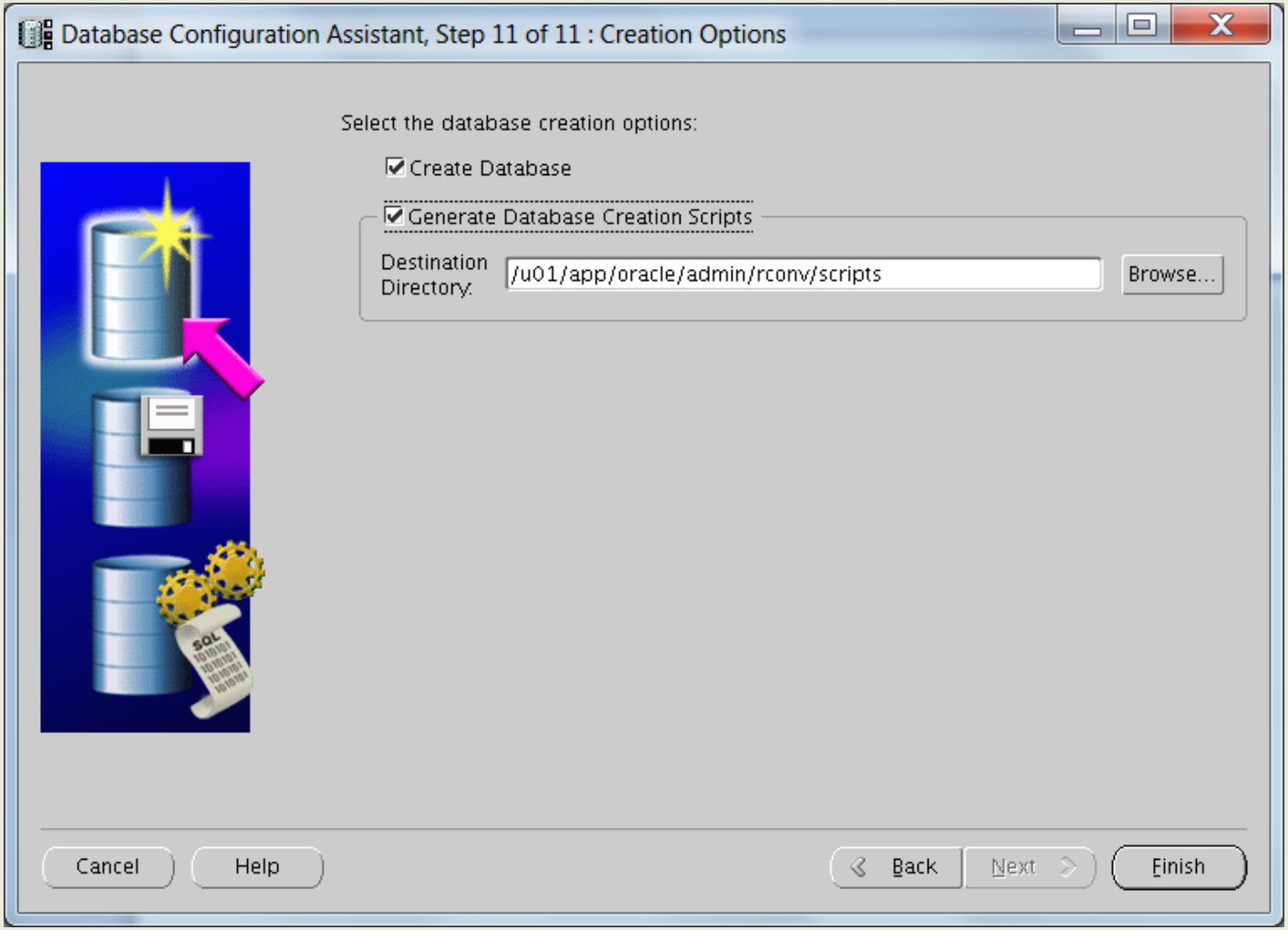
Create RAC database with dbca template for single instance database rconv



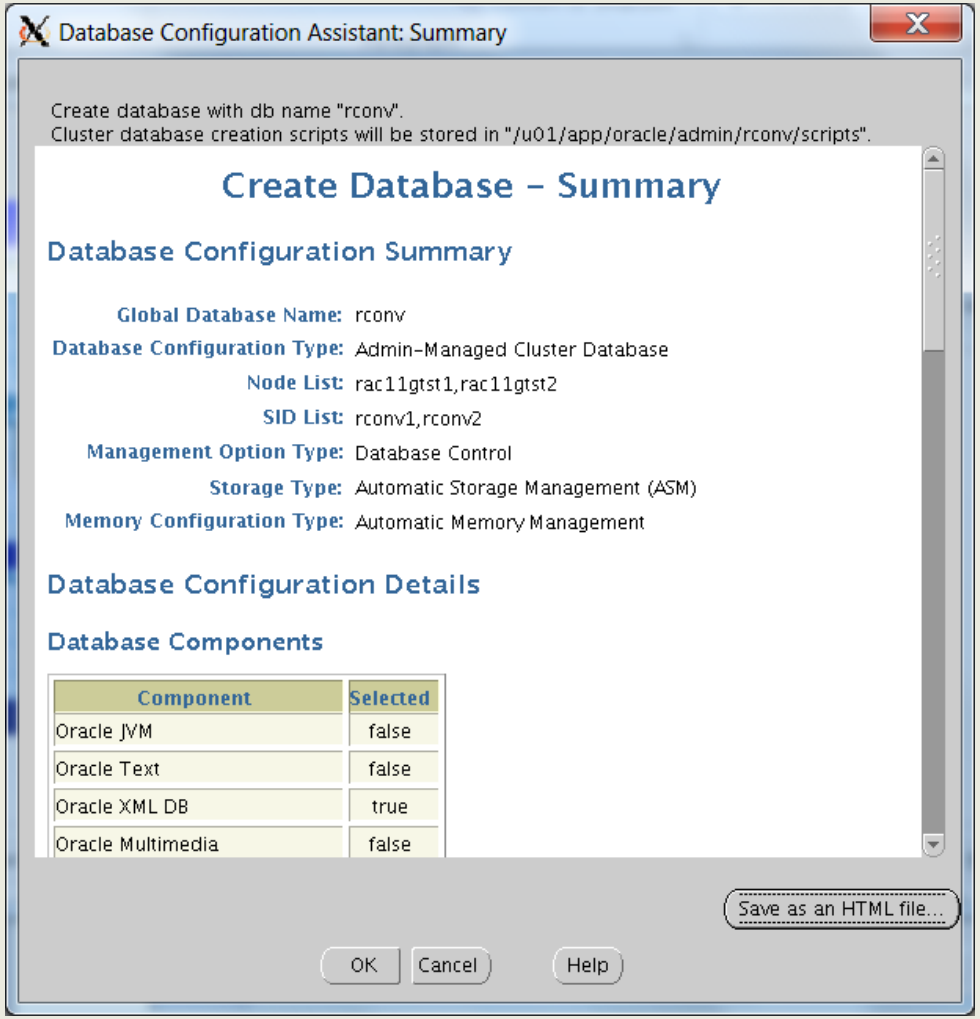
Exercise:
Create RAC database with dbca template for single instance database rconv



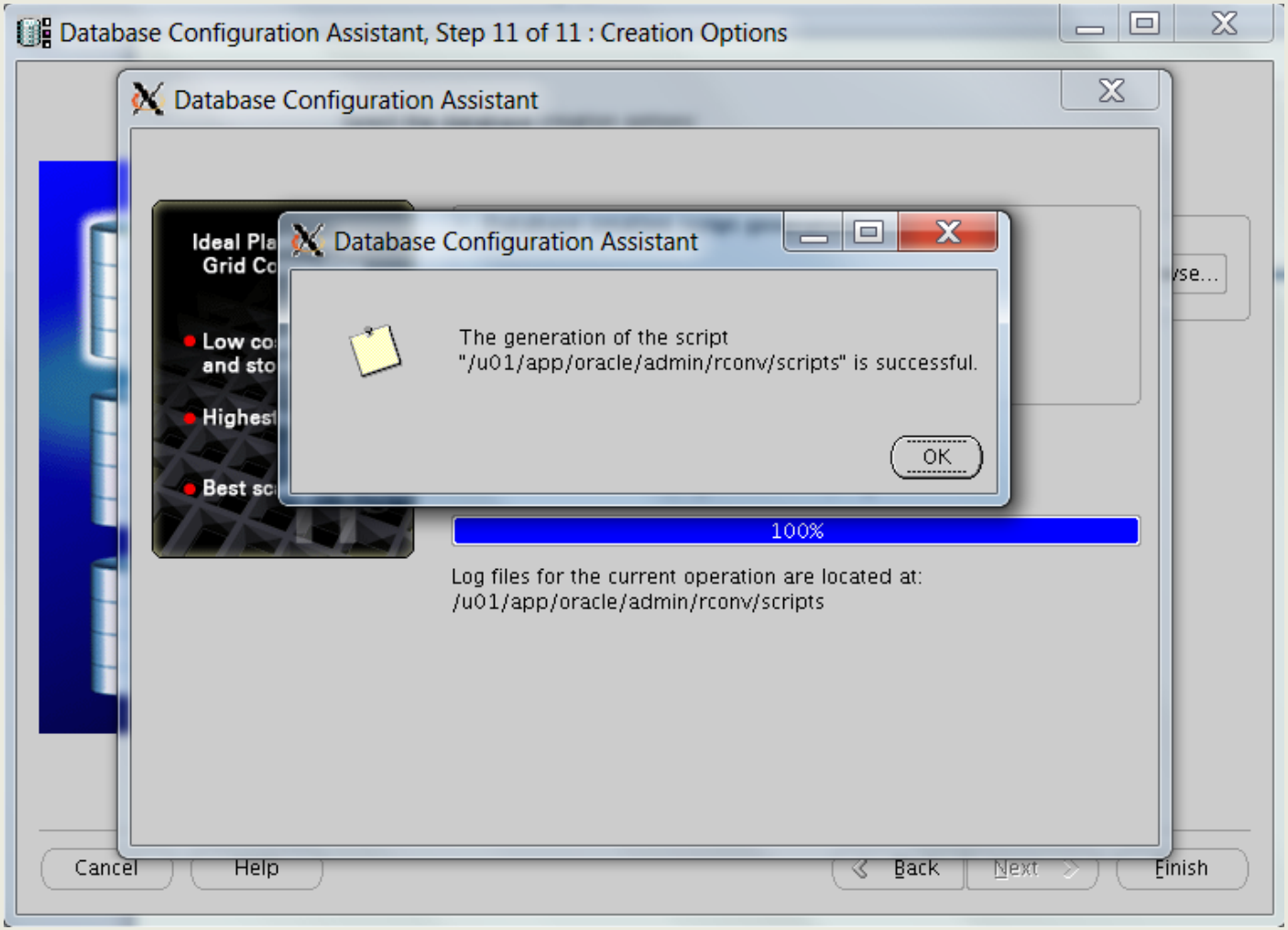
Exercise:
Create RAC database with dbca template for single instance database rconv



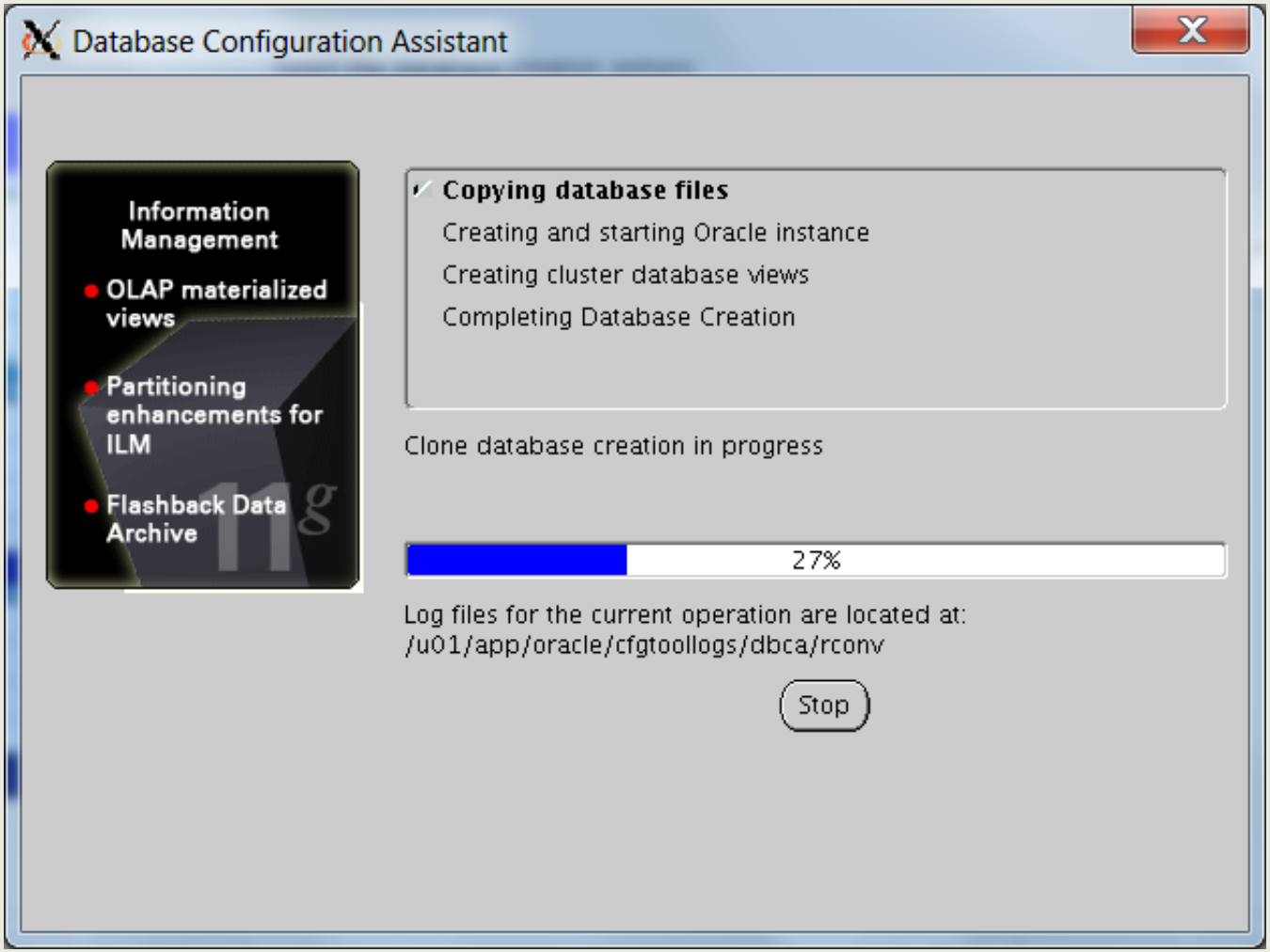
Exercise:
Create RAC database with dbca template for single instance database rconv



Exercise:
Create RAC database with dbca template for single instance database rconv



Exercise:
Create RAC database with dbca template for single instance database rconv



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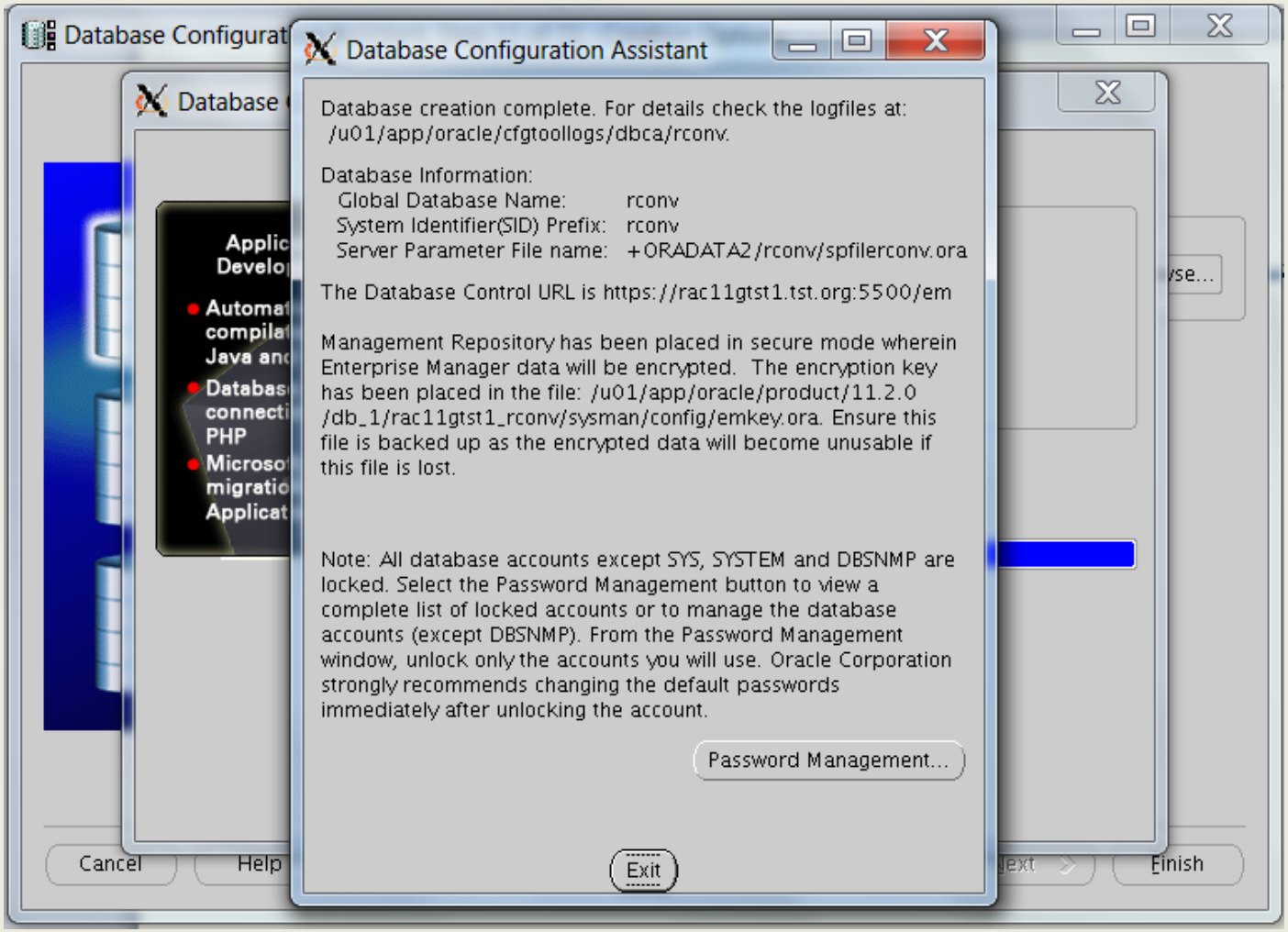


Exercise:
Create RAC database with dbca template for single instance database rconv

- Check RAC database status and configuration

  $ srvctl status database -d rconv
  Instance rconv1 is running on node rac11gtst1
  Instance rconv2 is running on node rac11gtst2

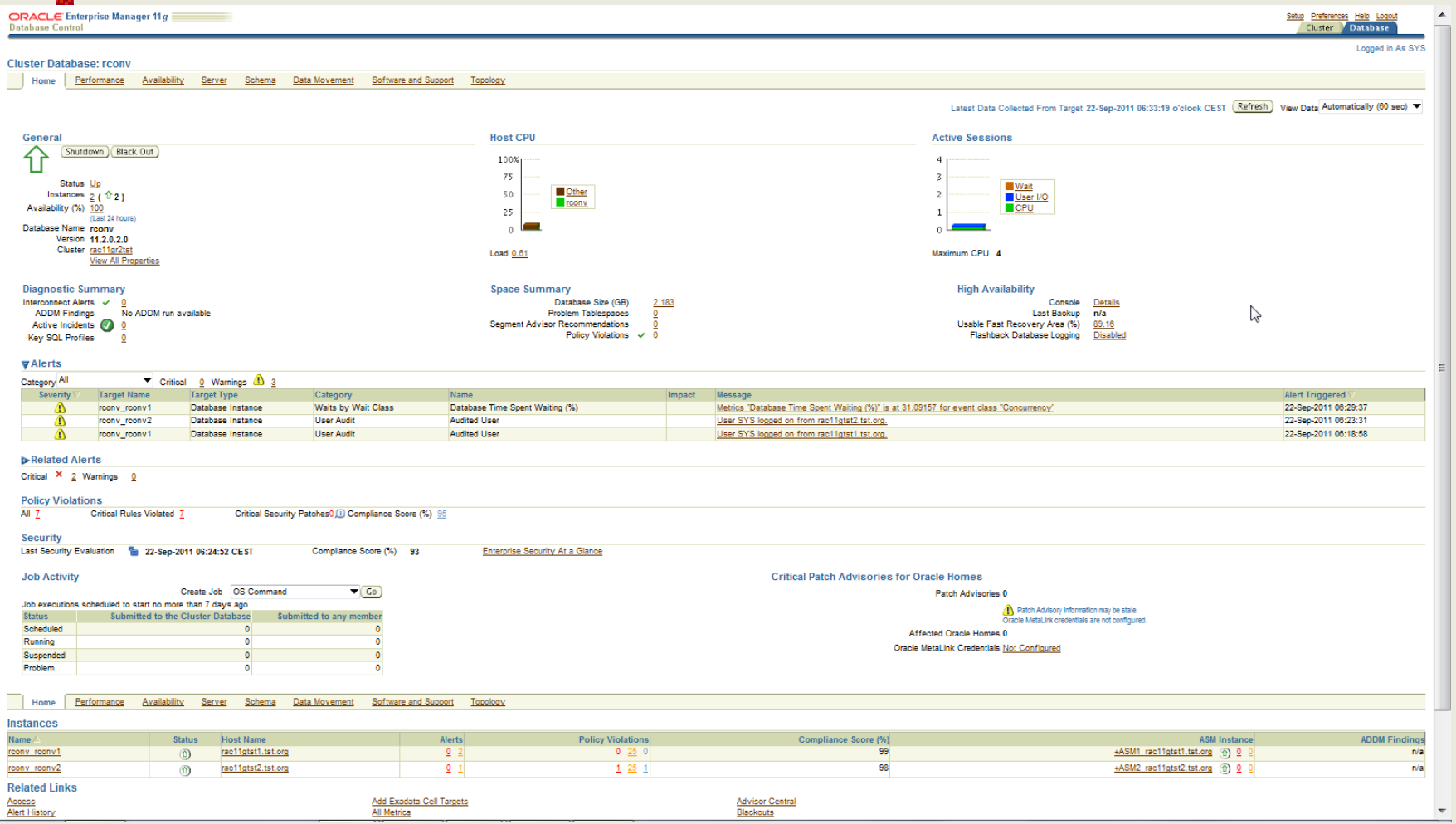
Exercise:
Create RAC database with dbca template for single instance database rconv


```
$ srvctl config database -d rconv
Database unique name: rconv
Database name: rconv
Oracle home: /u01/app/oracle/product/11.2.0/db_1
Oracle user: oracle
Spfile: +ORADATA2/rconv/spfilerconv.ora
Domain:
Start options: open
Stop options: immediate
Database role: PRIMARY
Management policy: AUTOMATIC
Server pools: rconv
Database instances: rconv1,rconv2
Disk Groups: ORADATA2,ORAFLASH
Mount point paths:
Services:
Type: RAC
Database is administrator managed
```

Exercise:
Create RAC database with dbca template for single instance database rconv

- Check if Enterprise Manager console is running with
  $. Rconv.env
  $ emctl status dbconsole
- Login to Enterprise Manager URL https://rac11gtst1.tst.org:5500/em from web browser as user sys
- Click on Database and then Cluster tab and check that pages are similar to those on the following two slides

Exercise:
Create RAC database with dbca template for single instance database rconv



Exercise:
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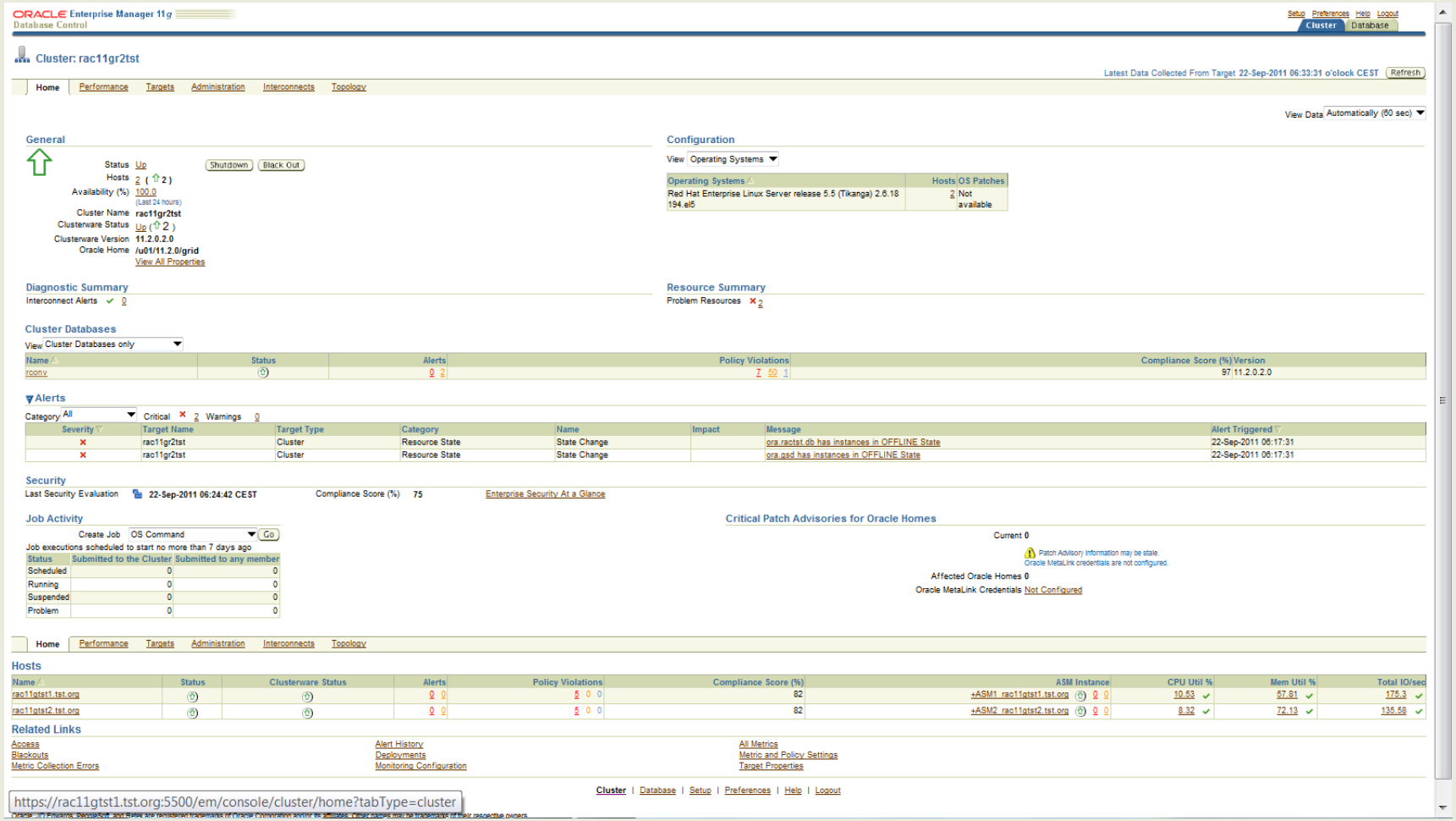


Administering Clusterware

- Oracle Clusterware is a software-based cluster manager that allows a group of physically separate servers to be combined into one logical server.
- The physical servers are connected together by a dedicated private network and are attached to shared storage.
- Oracle Clusterware consists of a set of additional processes and daemons that run on each node in the cluster and that utilize the private network and shared storage to coordinate activity between the servers

Administering Clusterware

- The goal of Clusterware is to manage local and cluster resources.
- Oracle 11.2 has many different types of
- resources, including the following:
  - Networks
  - VIP addresses
  - Local listeners
  - SCAN listeners
  - ASM instances
  - Databases
  - Database instances
  - Services
  - User-defined resources

Administering Clusterware

- Oracle Clusterware is responsible for determining the nodes on which resources should run.
- It can start, stop, and monitor resources; and it can optionally relocate resources to other nodes.
- Clusterware can also restart any processes that fail on their current node.
- Oracle Clusterware protects against hardware and software failures by providing failover capabilities.

Administering Clusterware

- In the event that a node or resource fails, Clusterware can be configured to relocate resources to other nodes in the cluster.
- Some resources that are tied to a specific node (an ASM instance, for example) cannot be relocated
- Clusterware can be used to reduce or eliminate planned downtime for hardware and software maintenance
- Oracle Clusterware can increase overall throughput by enabling the application to run on multiple nodes concurrently

Administering Clusterware

- Oracle Clusterware is also responsible for monitoring which nodes are currently members of the cluster.
- When a node joins or leaves the cluster this event will be detected by Oracle Clusterware and reported to all other nodes in the cluster.
- Clusterware allows the number of nodes in a cluster to be increased or decreased dynamically, thereby providing application scalability

Storing Cluster Information with the Oracle Cluster Registry

- The Oracle Cluster Registry (OCR) is used to store cluster configuration information.
- The OCR contains information about the resources controlled by Oracle Clusterware, including the following:
  - ASM disk groups, volumes, file systems, and instances
  - RAC databases and instances
  - SCAN listeners and local listeners
  - SCAN VIPs and local VIPs
  - Nodes and node applications
  - User-defined resources
  - Its own backups

Storing Cluster Information with the Oracle Cluster Registry

- Logically, the OCR represents a tree structure; physically, each element of data is stored in a separate 4096 byte physical block
- In Oracle 11*g*R2 and later, it is possible to configure up to five mirrored copies of the OCR.
- If there is more than one OCR mirror, then it is possible to replace a failed OCR mirror without an outage.
- In 11*g*R2, the OCR can be stored in an ASM disk group or a cluster file system

Storing Cluster Information with the Oracle Cluster Registry

- The OCR should only be updated by Oracle Clusterware processes, Enterprise Manager, supported utilities such as crsctl, srvctl, ocrconfig; and configuration tools such as the OUI, dbca, and netca

Storing Information in the Oracle Local Registry

- The Oracle Local Registry is the OCR's local counterpart and a new feature introduced with Grid Infrastructure.
- The information stored in the OLR is needed by the *Oracle High Availability Services daemon* (OHASD) to start; this includes data about GPnP wallets, Clusterware configuration, and version information.
- The OLR is maintained by the same command-line utilities as the OCR, with the appended -local option.
- Interestingly, the OLR is automatically backed up during an upgrade to Grid Infrastructure, whereas the OCR is not.

Fencing with the Voting Disk

- The voting disk is used to provide fencing and to determine cluster-node membership.
- During normal operations, the OCSSD daemon on each node in the cluster updates the voting disk once a second with the current status of that node.
- It then reads back the status structures of all other nodes in the cluster.
- In the event of an interconnect failure, all nodes in the cluster attempt to place a lock in the voting disk.
- If a node can lock a majority of the voting disks, then it gains control of the cluster

Fencing with the Voting Disk

- In 11*g*R2, the voting disk can be stored in an ASM disk group or a cluster file system
- In any configuration, there should always be an odd number of voting disks.
- In the event of an interconnect failure in a two node-cluster, this ensures that one node always secures a majority of voting disks.
- For clusters containing three or more nodes, a more complex algorithm is used to determine which node ultimately controls the cluster

Recording Information with the Grid Plug and Play Profile

- The GPnP profile is an important part of the new 11.2 Grid Infrastructure, and it records a lot of important information about the cluster itself.
- The file is signed to prevent modifications, and administrators generally should not edit it by administrators.
- The profile is an XML document, which is the main reason why adding nodes requires a lot less input from the administrator
- Oracle uses the GPnP profile and the information stored in the OCR when adding a node to the cluster.

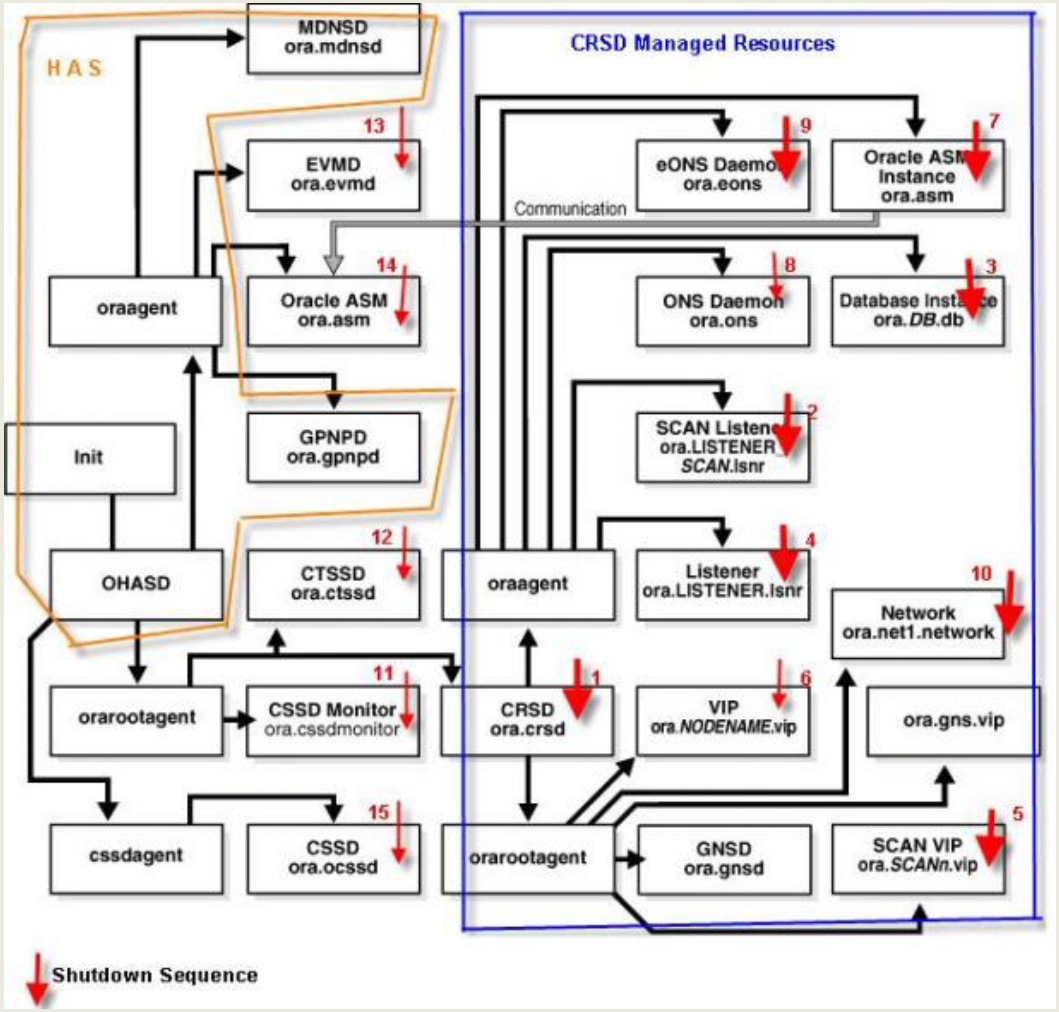
Grid Infrastructure Software Stacks

- Oracle re-architected Grid Infrastructure into two different stacks.
- The official documentation refers to them as the High Availability Services stack and the Cluster Ready Services stack
- The High Availability Services stack consists of daemons that communicate with their peers on the other nodes.
- As soon as the High Availability Services stack is up, the cluster node can join the cluster and use the shared components (e.g., the OCR).

Grid Infrastructure Software Stacks

- The startup sequence of the High Availability Services stack is stored partly in the Grid Plug and Play profile, but that sequence also depends on information stored in the OLR.

Grid Infrastructure Software Stacks



Managing Oracle Clusterware

- Oracle provides a comprehensive set of tools that can be used to manage Oracle Grid Infrastructure, including the following:
  - Enterprise Manager
  - The crsctl utility
  - The srvctl utility
  - Cluster Verification Utility
  - The oifcfg utility
  - The ocrconfig utility
  - The ocrcheck utility
  - The ocrdump utility

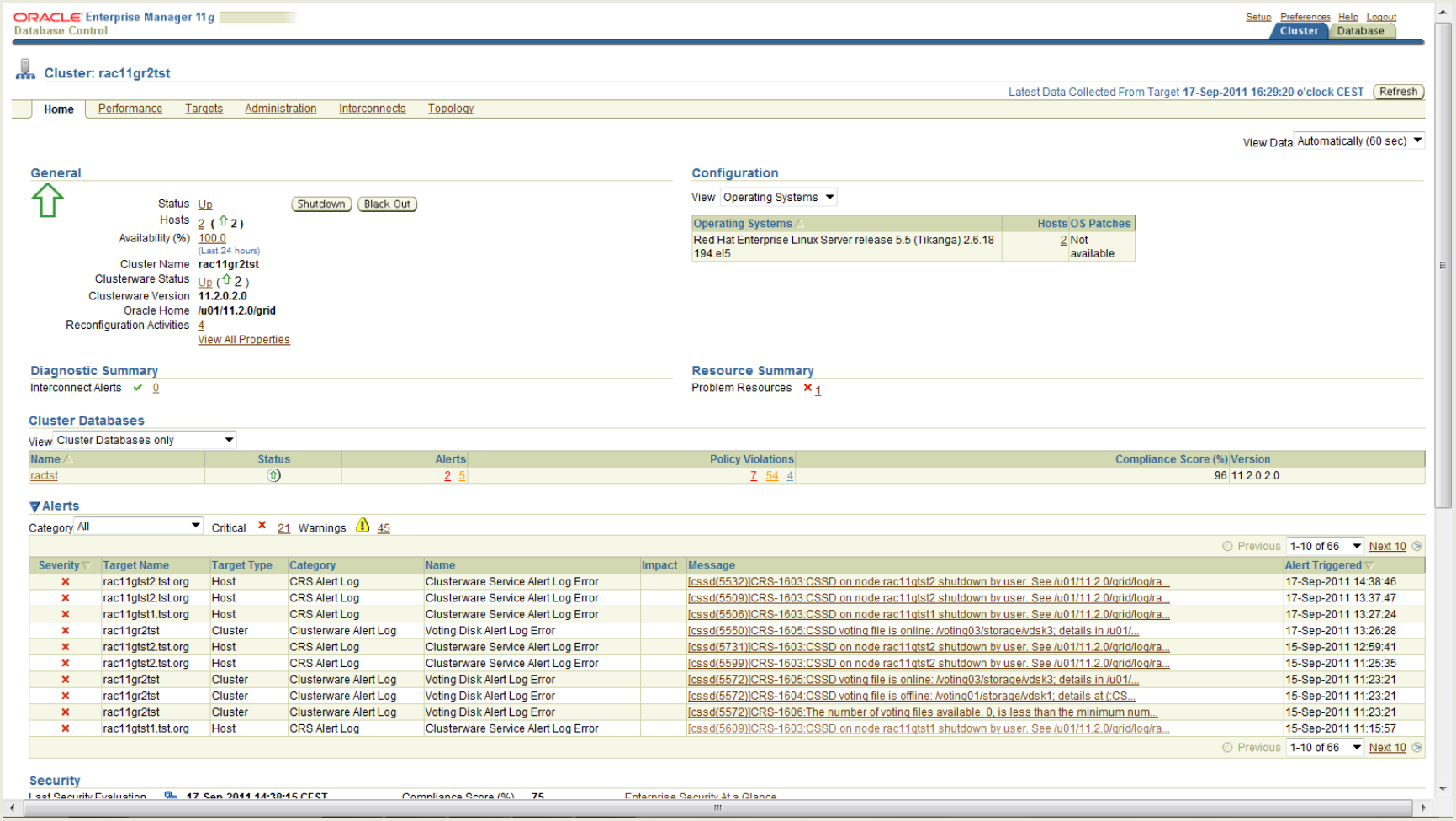
Using the Enterprise Manager

- Both Enterprise Manager Database Control and Enterprise Manager Grid Control can be used to manage Oracle Clusterware environments.
- The functionality of Enterprise Manager Database Control is restricted to managing a single database that may have multiple instances.
- If Enterprise Manager Database Control is deployed, then the management repository must be stored in the target database

Using the Enterprise Manager

- Enterprise Manager Grid Control provides a much more flexible management solution, and many Oracle sites now use this tool to manage their entire Oracle estate.
- The Enterprise Manager Grid Control management repository can be stored in a separate database, outside the cluster.
- Enterprise Manager Grid Control supports a wider range of administrative tasks, such as the ability to configure and maintain Data Guard.

Using the Enterprise Manager



Using the Enterprise Manager

Name	Status	Alerts	Policy Violations	Compliance Score (%)	Version
ractst	⇧	3 3	7 54 4	96	11.2.0.2.0

Alerts

Category All Critical 21 Warnings 45

Previous 1-10 of 66 Next 10

Severity	Target Name	Target Type	Category	Name	Impact	Message	Alert Triggered
×	rac11gtst2.tst.org	Host	CRS Alert Log	Clusterware Service Alert Log Error		[cssd(5532)]CRS-1603:CSSD on node rac11gtst2 shutdown by user. See /u01/11.2.0/grid/log/ra...	17-Sep-2011 14:38:46
×	rac11gtst2.tst.org	Host	CRS Alert Log	Clusterware Service Alert Log Error		[cssd(5509)]CRS-1603:CSSD on node rac11gtst2 shutdown by user. See /u01/11.2.0/grid/log/ra...	17-Sep-2011 13:37:47
×	rac11gtst1.tst.org	Host	CRS Alert Log	Clusterware Service Alert Log Error		[cssd(5506)]CRS-1603:CSSD on node rac11gtst1 shutdown by user. See /u01/11.2.0/grid/log/ra...	17-Sep-2011 13:27:24
×	rac11gr2tst	Cluster	Clusterware Alert Log	Voting Disk Alert Log Error		[cssd(5550)]CRS-1605:CSSD voting file is online: /voting03/storage/vdsk3; details in /u01/...	17-Sep-2011 13:26:28
×	rac11gtst2.tst.org	Host	CRS Alert Log	Clusterware Service Alert Log Error		[cssd(5731)]CRS-1603:CSSD on node rac11gtst2 shutdown by user. See /u01/11.2.0/grid/log/ra...	15-Sep-2011 12:59:41
×	rac11gtst2.tst.org	Host	CRS Alert Log	Clusterware Service Alert Log Error		[cssd(5599)]CRS-1603:CSSD on node rac11gtst2 shutdown by user. See /u01/11.2.0/grid/log/ra...	15-Sep-2011 11:25:35
×	rac11gr2tst	Cluster	Clusterware Alert Log	Voting Disk Alert Log Error		[cssd(5572)]CRS-1605:CSSD voting file is online: /voting03/storage/vdsk3; details in /u01/...	15-Sep-2011 11:23:21
×	rac11gr2tst	Cluster	Clusterware Alert Log	Voting Disk Alert Log Error		[cssd(5572)]CRS-1604:CSSD voting file is offline: /voting01/storage/vdsk1; details at (:CS...	15-Sep-2011 11:23:21
×	rac11gr2tst	Cluster	Clusterware Alert Log	Voting Disk Alert Log Error		[cssd(5572)]CRS-1606:The number of voting files available, 0, is less than the minimum num...	15-Sep-2011 11:23:21
×	rac11gtst1.tst.org	Host	CRS Alert Log	Clusterware Service Alert Log Error		[cssd(5609)]CRS-1603:CSSD on node rac11gtst1 shutdown by user. See /u01/11.2.0/grid/log/ra...	15-Sep-2011 11:15:57

Previous 1-10 of 66 Next 10

Security

Last Security Evaluation 17-Sep-2011 14:38:15 CEST Compliance Score (%) 75 Enterprise Security At a Glance

Job Activity

Create Job OS Command Go

Job executions scheduled to start no more than 7 days ago

Status	Submitted to the Cluster	Submitted to any member
Scheduled	0	0
Running	0	0
Suspended	0	0
Problem	0	0

Critical Patch Advisories for Oracle Homes

Current 26

Affected Oracle Homes 4

Home | Performance | Targets | Administration | Interconnects | Topology

Hosts

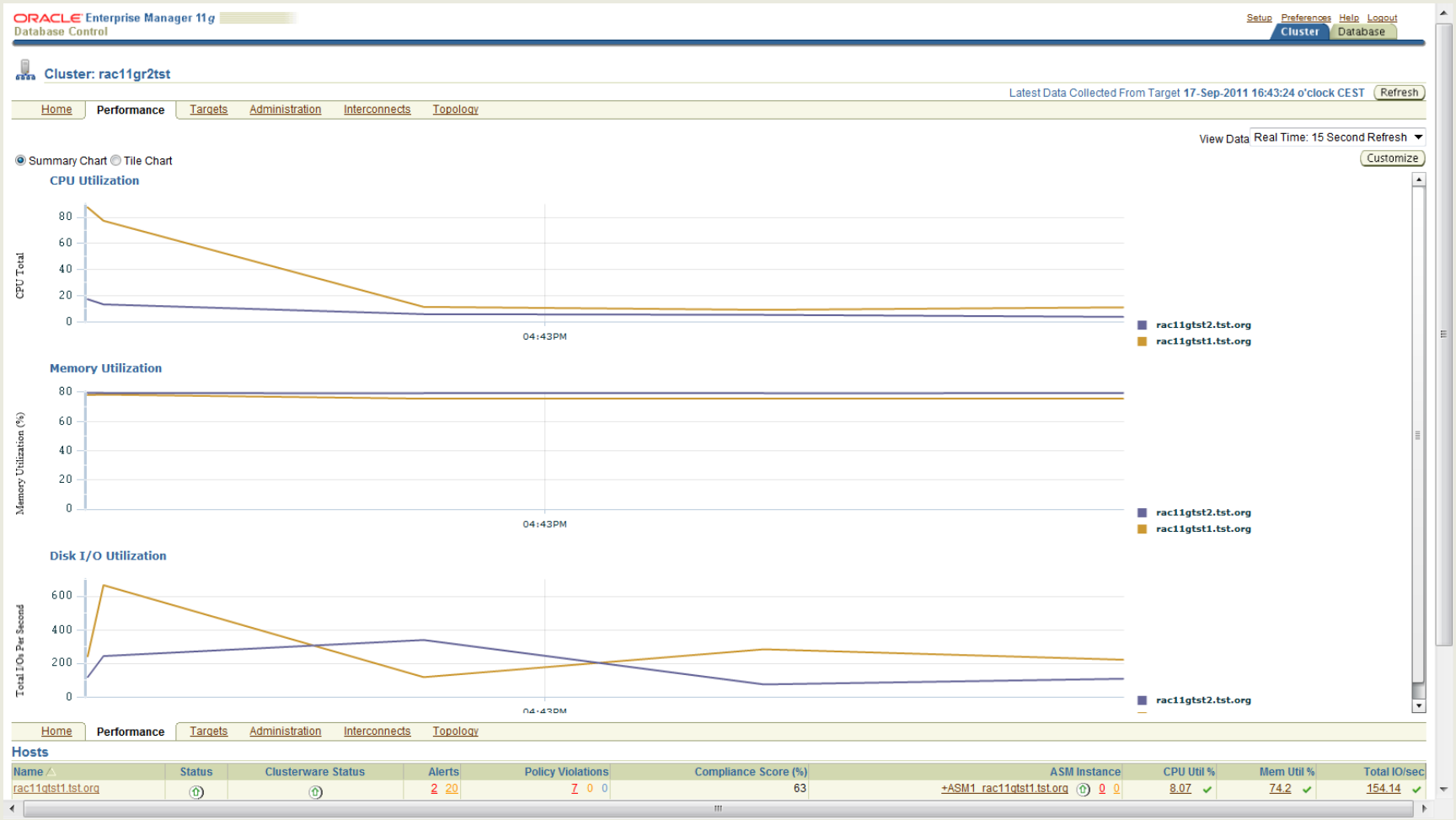
Name	Status	Clusterware Status	Alerts	Policy Violations	Compliance Score (%)	ASM Instance	CPU Util %	Mem Util %	Total IO/sec
rac11gtst1.tst.org	⇧	⇧	2 20	7 0 0	63	+ASM1_rac11gtst1.tst.org ⇧ 0 0	7.49 ✓	74.14 ✓	165.98 ✓
rac11gtst2.tst.org	⇧	⇧	4 16	7 0 0	63	+ASM2_rac11gtst2.tst.org ⇧ 0 0	5.76 ✓	78.32 ✓	143.22 ✓

Related Links

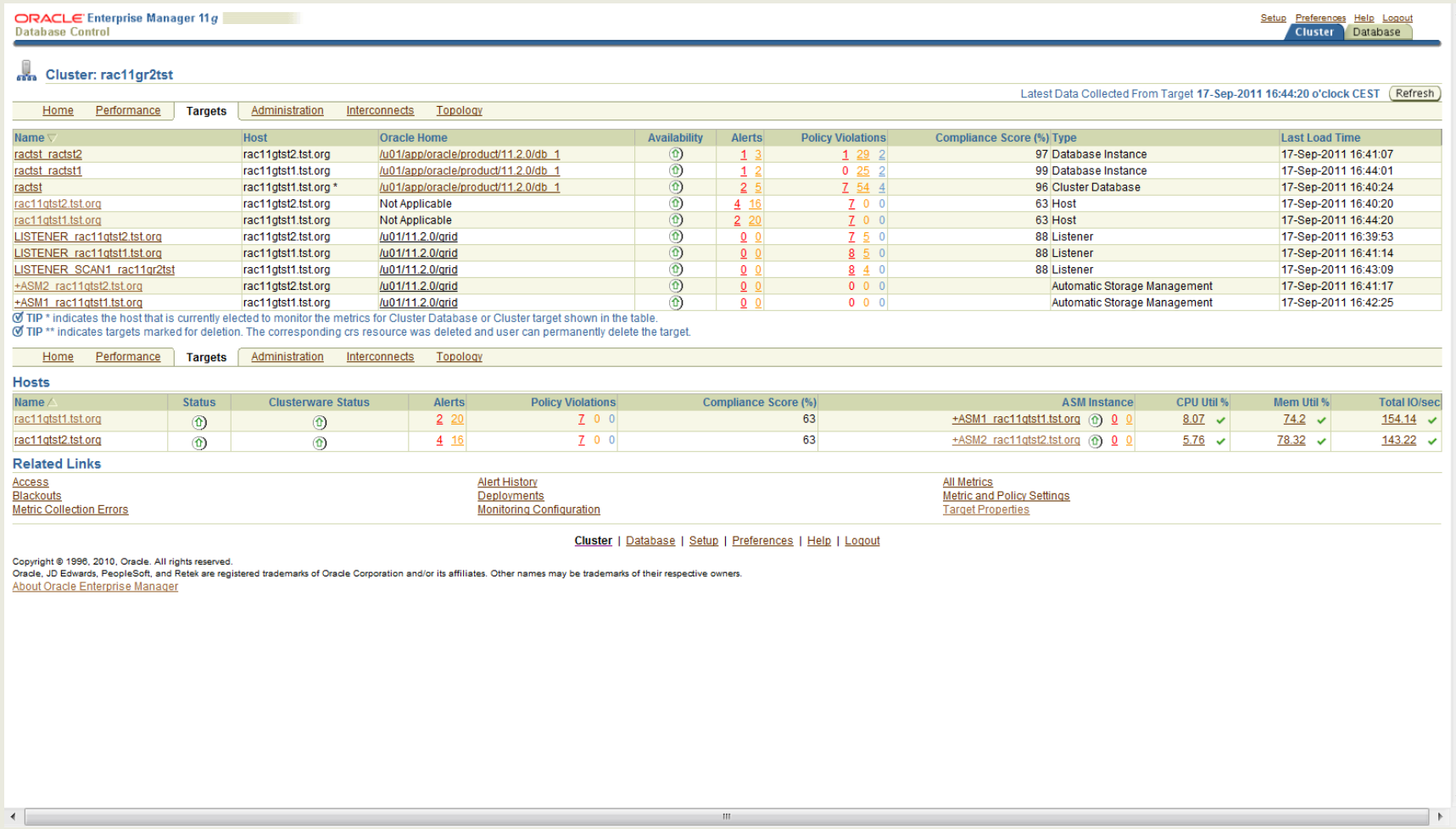
Access
Blackouts
Metric Collection Errors
Alert History
Deployments
Monitoring Configuration
All Metrics
Metric and Policy Settings
Target Properties

Cluster | Database | Setup | Preferences | Help | Logout

Using the Enterprise Manager



Using the Enterprise Manager



ORACLE Enterprise Manager 11g
Database Control

Setup | Preferences | Help | Logout
Cluster | Database

Cluster: rac11gr2tst

Latest Data Collected From Target **17-Sep-2011 16:44:20 o'clock CEST** Refresh

Home | Performance | **Targets** | Administration | Interconnects | Topology

Name	Host	Oracle Home	Availability	Alerts	Policy Violations	Compliance Score (%)	Type	Last Load Time
ractst_ractst2	rac11gtst2.tst.org	/u01/app/oracle/product/11.2.0/db_1	↑	1 3	1 29 2	97	Database Instance	17-Sep-2011 16:41:07
ractst_ractst1	rac11gtst1.tst.org	/u01/app/oracle/product/11.2.0/db_1	↑	1 2	0 25 2	99	Database Instance	17-Sep-2011 16:44:01
ractst	rac11gtst1.tst.org *	/u01/app/oracle/product/11.2.0/db_1	↑	2 5	7 54 4	96	Cluster Database	17-Sep-2011 16:40:24
rac11gtst2.tst.org	rac11gtst2.tst.org	Not Applicable	↑	4 16	7 0 0	63	Host	17-Sep-2011 16:40:20
rac11gtst1.tst.org	rac11gtst1.tst.org	Not Applicable	↑	2 20	7 0 0	63	Host	17-Sep-2011 16:44:20
LISTENER_rac11gtst2.tst.org	rac11gtst2.tst.org	/u01/11.2.0/grid	↑	0 0	7 5 0	88	Listener	17-Sep-2011 16:39:53
LISTENER_rac11gtst1.tst.org	rac11gtst1.tst.org	/u01/11.2.0/grid	↑	0 0	8 5 0	88	Listener	17-Sep-2011 16:41:14
LISTENER_SCAN1_rac11gr2tst	rac11gtst1.tst.org	/u01/11.2.0/grid	↑	0 0	8 4 0	88	Listener	17-Sep-2011 16:43:09
+ASM2_rac11gtst2.tst.org	rac11gtst2.tst.org	/u01/11.2.0/grid	↑	0 0	0 0 0		Automatic Storage Management	17-Sep-2011 16:41:17
+ASM1_rac11gtst1.tst.org	rac11gtst1.tst.org	/u01/11.2.0/grid	↑	0 0	0 0 0		Automatic Storage Management	17-Sep-2011 16:42:25

TIP * indicates the host that is currently elected to monitor the metrics for Cluster Database or Cluster target shown in the table.
TIP ** indicates targets marked for deletion. The corresponding crs resource was deleted and user can permanently delete the target.

Home | Performance | **Targets** | Administration | Interconnects | Topology

Hosts

Name	Status	Clusterware Status	Alerts	Policy Violations	Compliance Score (%)	ASM Instance	CPU Util %	Mem Util %	Total IO/sec
rac11gtst1.tst.org	↑	↑	2 20	7 0 0	63	+ASM1_rac11gtst1.tst.org ↑ 0 0	8.07 ✓	74.2 ✓	154.14 ✓
rac11gtst2.tst.org	↑	↑	4 16	7 0 0	63	+ASM2_rac11gtst2.tst.org ↑ 0 0	5.76 ✓	78.32 ✓	143.22 ✓

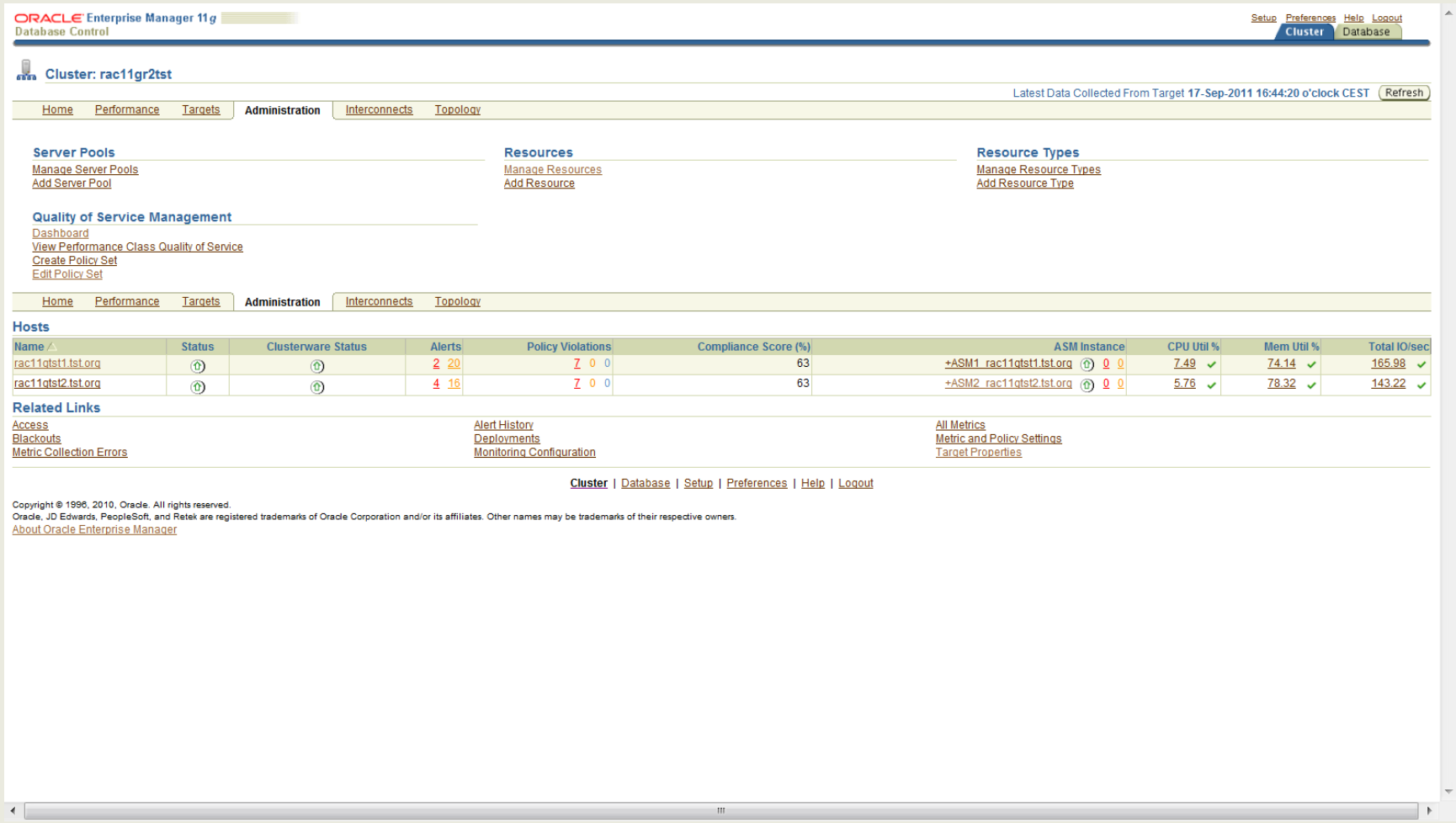
Related Links

Access
Blackouts
Metric Collection Errors
Alert History
Deployments
Monitoring Configuration
All Metrics
Metric and Policy Settings
Target Properties

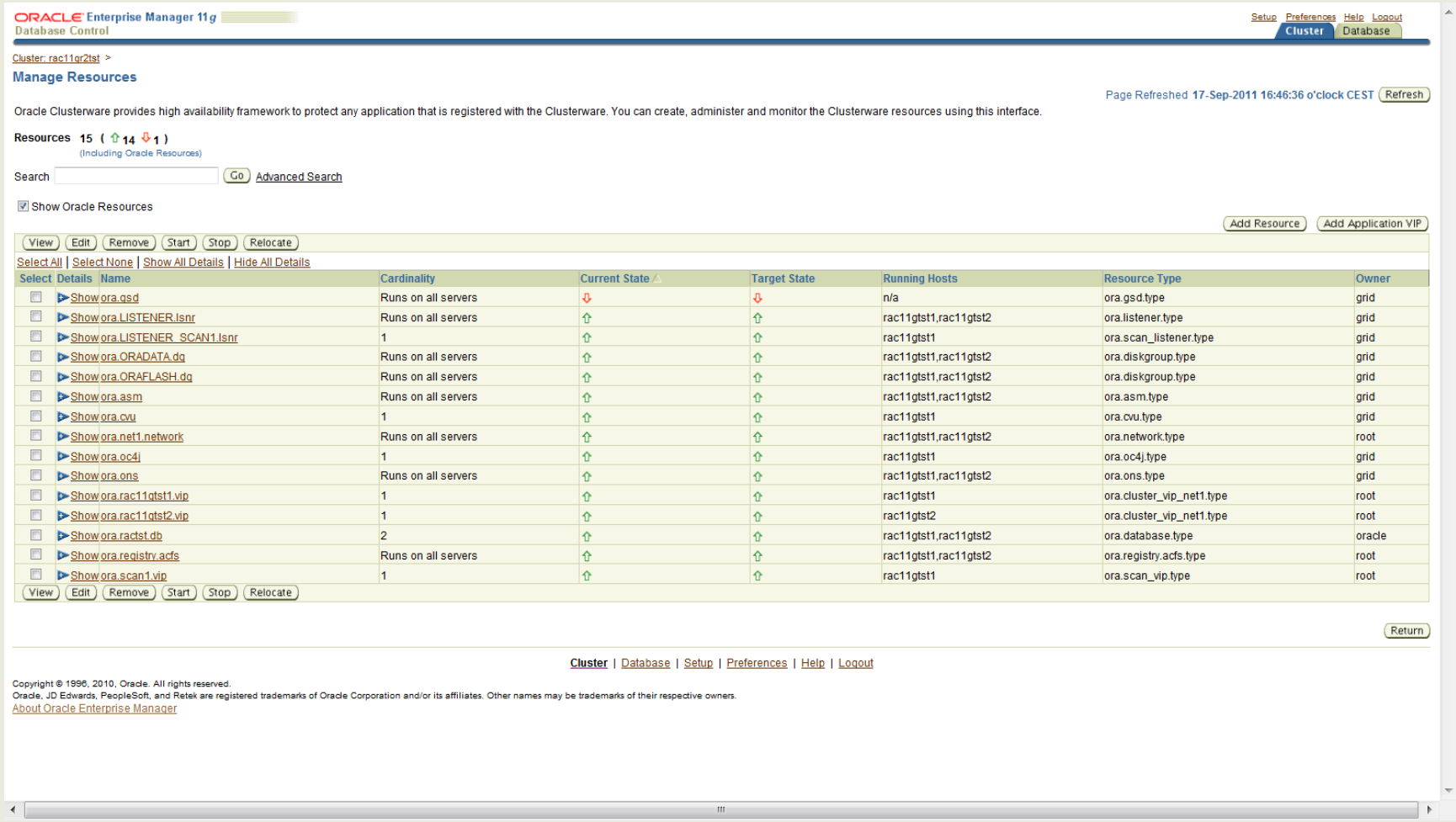
Cluster | Database | Setup | Preferences | Help | Logout

About Oracle Enterprise Manager

Using the Enterprise Manager



Using the Enterprise Manager



ORACLE Enterprise Manager 11g
Database Control

Setup | Preferences | Help | Logout
Cluster | Database

Cluster: rac11gr2tst >

Manage Resources

Page Refreshed 17-Sep-2011 16:46:36 o'clock CEST [Refresh]

Oracle Clusterware provides high availability framework to protect any application that is registered with the Clusterware. You can create, administer and monitor the Clusterware resources using this interface.

Resources 15 (⇧14 ⇩1)
(Including Oracle Resources)

Search [Go] Advanced Search

☑ Show Oracle Resources

[Add Resource] [Add Application VIP]

[View] [Edit] [Remove] [Start] [Stop] [Relocate]

Select All | Select None | Show All Details | Hide All Details

Select	Details	Name	Cardinality	Current State	Target State	Running Hosts	Resource Type	Owner
☐	Show	ora.gsd	Runs on all servers	⇩	⇩	n/a	ora.gsd.type	grid
☐	Show	ora.LISTENER.lsnr	Runs on all servers	⇧	⇧	rac11gtst1,rac11gtst2	ora.listener.type	grid
☐	Show	ora.LISTENER_SCAN1.lsnr	1	⇧	⇧	rac11gtst1	ora.scan_listener.type	grid
☐	Show	ora.ORADATA.dg	Runs on all servers	⇧	⇧	rac11gtst1,rac11gtst2	ora.diskgroup.type	grid
☐	Show	ora.ORAFLASH.dg	Runs on all servers	⇧	⇧	rac11gtst1,rac11gtst2	ora.diskgroup.type	grid
☐	Show	ora.asm	Runs on all servers	⇧	⇧	rac11gtst1,rac11gtst2	ora.asm.type	grid
☐	Show	ora.cvu	1	⇧	⇧	rac11gtst1	ora.cvu.type	grid
☐	Show	ora.net1.network	Runs on all servers	⇧	⇧	rac11gtst1,rac11gtst2	ora.network.type	root
☐	Show	ora.oc4j	1	⇧	⇧	rac11gtst1	ora.oc4j.type	grid
☐	Show	ora.ons	Runs on all servers	⇧	⇧	rac11gtst1,rac11gtst2	ora.ons.type	grid
☐	Show	ora.rac11gtst1.vip	1	⇧	⇧	rac11gtst1	ora.cluster_vip_net1.type	root
☐	Show	ora.rac11gtst2.vip	1	⇧	⇧	rac11gtst2	ora.cluster_vip_net1.type	root
☐	Show	ora.ractst.db	2	⇧	⇧	rac11gtst1,rac11gtst2	ora.database.type	oracle
☐	Show	ora.registry.acfs	Runs on all servers	⇧	⇧	rac11gtst1,rac11gtst2	ora.registry.acfs.type	root
☐	Show	ora.scan1.vip	1	⇧	⇧	rac11gtst1	ora.scan_vip.type	root

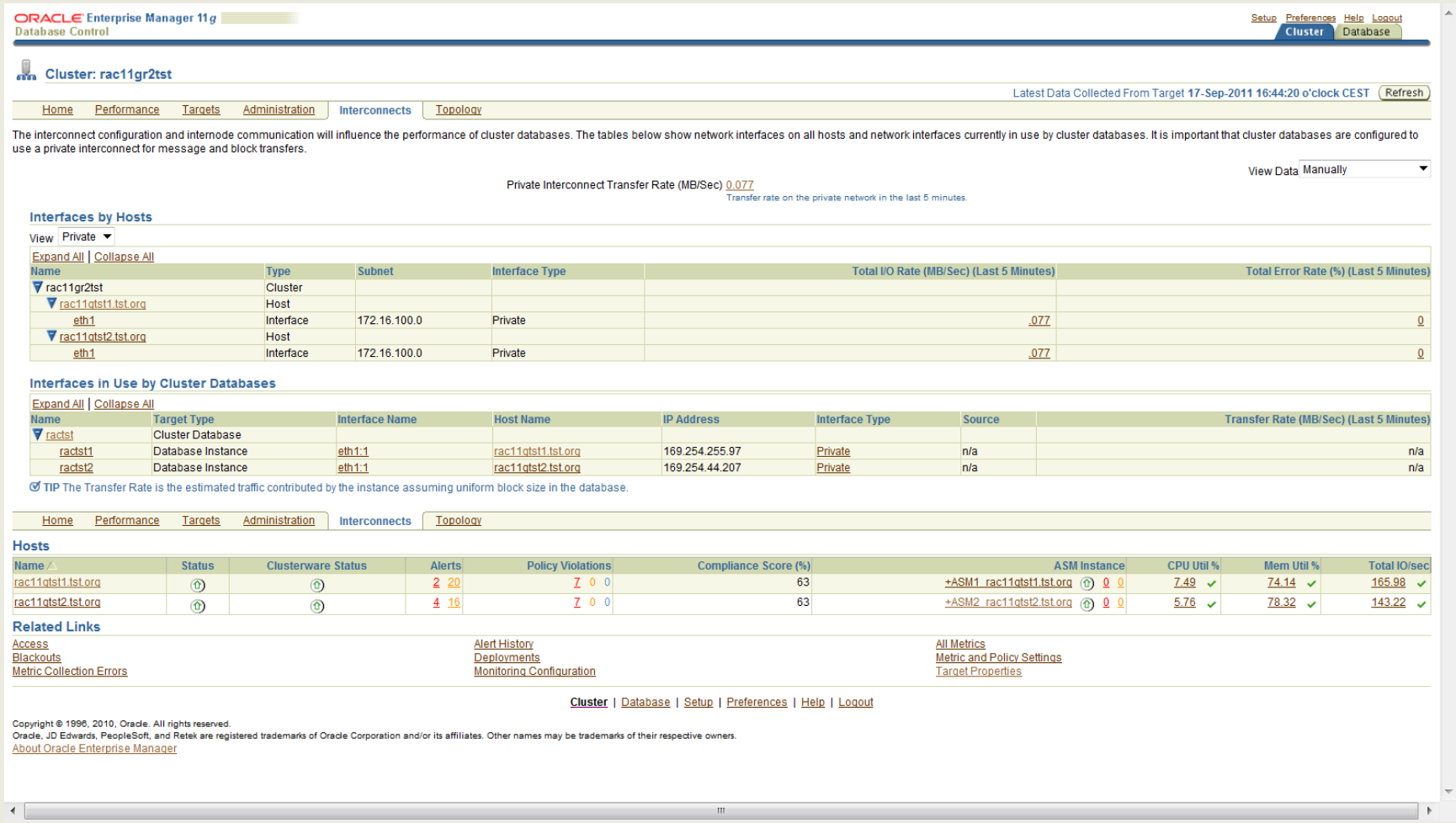
[View] [Edit] [Remove] [Start] [Stop] [Relocate]

[Return]

Cluster | Database | Setup | Preferences | Help | Logout

About Oracle Enterprise Manager

Using the Enterprise Manager



ORACLE Enterprise Manager 11g
Database Control

Setup | Preferences | Help | Logout
Cluster | Database

Cluster: rac11gr2tst

Latest Data Collected From Target **17-Sep-2011 16:44:20 o'clock CEST** Refresh

Home | Performance | Targets | Administration | Interconnects | Topology

The interconnect configuration and internode communication will influence the performance of cluster databases. The tables below show network interfaces on all hosts and network interfaces currently in use by cluster databases. It is important that cluster databases are configured to use a private interconnect for message and block transfers.

View Data: Manually

Private Interconnect Transfer Rate (MB/Sec) 0.077
Transfer rate on the private network in the last 5 minutes.

Interfaces by Hosts

View: Private

Expand All | Collapse All

Name	Type	Subnet	Interface Type	Total I/O Rate (MB/Sec) (Last 5 Minutes)	Total Error Rate (%) (Last 5 Minutes)
rac11gr2tst	Cluster				
rac11qtst1.tst.org	Host				
eth1	Interface	172.16.100.0	Private	.077	0
rac11qtst2.tst.org	Host				
eth1	Interface	172.16.100.0	Private	.077	0

Interfaces in Use by Cluster Databases

Expand All | Collapse All

Name	Target Type	Interface Name	Host Name	IP Address	Interface Type	Source	Transfer Rate (MB/Sec) (Last 5 Minutes)
ractst	Cluster Database						
ractst1	Database Instance	eth1:1	rac11qtst1.tst.org	169.254.255.97	Private	n/a	n/a
ractst2	Database Instance	eth1:1	rac11qtst2.tst.org	169.254.44.207	Private	n/a	n/a

TIP The Transfer Rate is the estimated traffic contributed by the instance assuming uniform block size in the database.

Home | Performance | Targets | Administration | Interconnects | Topology

Hosts

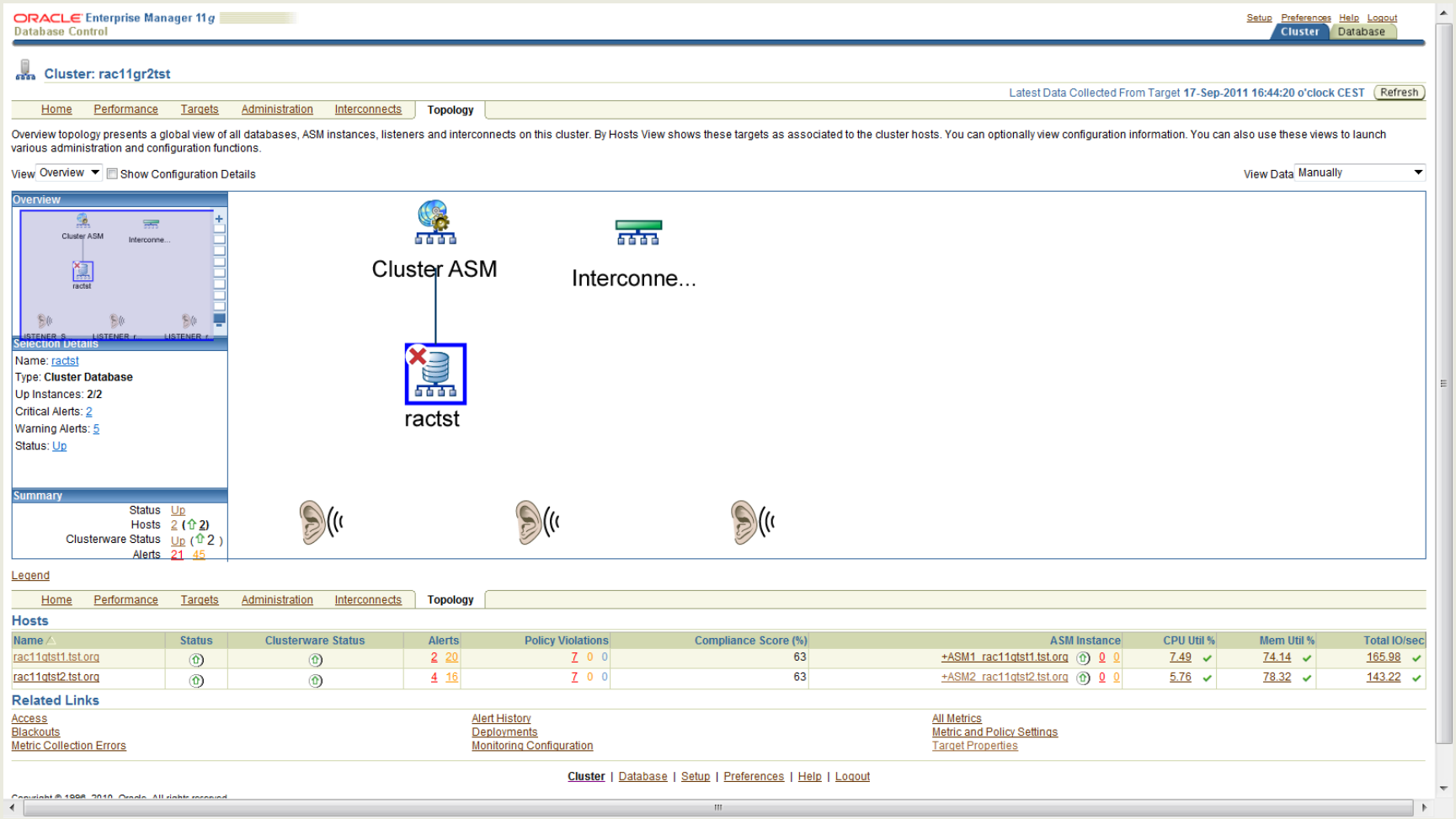
Name	Status	Clusterware Status	Alerts	Policy Violations	Compliance Score (%)	ASM Instance	CPU Util %	Mem Util %	Total IO/sec
rac11qtst1.tst.org	↑	↑	2 20	7 0 0	63	+ASM1_rac11qtst1.tst.org ↑ 0 0	7.49 ✓	74.14 ✓	165.98 ✓
rac11qtst2.tst.org	↑	↑	4 16	7 0 0	63	+ASM2_rac11qtst2.tst.org ↑ 0 0	5.76 ✓	78.32 ✓	143.22 ✓

Related Links

Access
Blackouts
Metric Collection Errors
Alert History
Deployments
Monitoring Configuration
All Metrics
Metric and Policy Settings
Target Properties

Cluster | Database | Setup | Preferences | Help | Logout

Using the Enterprise Manager



Exercise: Managing clusterware with Enterprise Manager

- Connect to Enterprise Manager Database Control
- Navigate through clusterware pages: General, Performance, Targets, Administration, Interconnects, Topology

Using the Clusterware Control Utility

- The Clusterware Control Utility crsctl is the primary command-line tool for managing Oracle Clusterware
- In Oracle 11*g*R2, crsctl has been extended to include cluster-aware commands that can be used to start and stop Clusterware on some or all nodes in the cluster.
- It can also be used to monitor and manage the configuration of the voting disks and to configure and manage individual cluster resources.

Using the Clusterware Control Utility

- The crsctl utility also supports new functionality, such as the configuration of administrative privileges to ensure role separation.
- To manually start and stop Oracle Clusterware on all nodes in the cluster, execute the following commands as the root user:

```
# crsctl start cluster -all
# crsctl stop cluster –all
```

Alternatively, you could use the -n switch to start Grid Infrastructure on a specific (not local) node

Using the Clusterware Control Utility

- To check the current status of all nodes in the cluster, execute the following command
  # crsctl check cluster –all
- In Oracle 11*g*R2 and later, the crs_stat utility has been deprecated.
- However, this utility is still shipped to provide backwards compatibility.
- The functionality of crs_stat has been integrated into the crsctl utility.
- You can use
  # crsctl status resource –t
  to list the current status of all resources

Using the Clusterware Control Utility

- The output of the crsctl status resource command does not list the daemons of the High Availability Services stack!
- You must use the initially undocumented -init option to accomplish this:
  # crsctl status resource -t –init
- you can initiate a resource using
  # crsctl start resource *resourceName*
  and stop it using
  # crsctl stop resource *resourceName*.

Using the Clusterware Control Utility

- If Oracle Support recommends doing so, you can stop resources of the High Availability Services stack by appending the -init parameter to crsctl start/stop resource *resourceName*

Using the Clusterware Control Utility


```
$ crsctl
Usage: crsctl check crs - checks the viability of the CRS stack
crsctl check cssd - checks the viability of CSS
crsctl check crsd - checks the viability of CRS
crsctl check evmd - checks the viability of EVM
crsctl set css <parameter> <value> - sets a parameter override
crsctl get css <parameter> - gets the value of a CSS parameter
crsctl unset css <parameter> - sets CSS parameter to its default
crsctl query css votedisk - lists the voting disks used by CSS
crsctl add css votedisk <path> - adds a new voting disk
crsctl delete css votedisk <path> - removes a voting disk
crsctl enable crs - enables startup for all CRS daemons
crsctl disable crs - disables startup for all CRS daemons
crsctl start crs - starts all CRS daemons.
crsctl stop crs - stops all CRS daemons. Stops CRS resources in case of cluster.
crsctl start resources - starts CRS resources.
crsctl stop resources - stops CRS resources.
```

Using the Clusterware Control Utility

crsctl debug statedump evm - dumps state info for evm objects
crsctl debug statedump crs - dumps state info for crs objects
crsctl debug statedump css - dumps state info for css objects
crsctl debug log css [module:level]{,module:level} ...
- Turns on debugging for CSS
crsctl debug trace css - dumps CSS in-memory tracing cache
crsctl debug log crs [module:level]{,module:level} ...
- Turns on debugging for CRS
crsctl debug trace crs - dumps CRS in-memory tracing cache
crsctl debug log evm [module:level]{,module:level} ...
- Turns on debugging for EVM
crsctl debug trace evm - dumps EVM in-memory tracing cache
crsctl debug log res <resname:level> turns on debugging for **resources**
crsctl query crs softwareversion [<nodename>] - lists the version **of CRS software installed**
crsctl query crs activeversion - lists the CRS software operating **version**
crsctl lsmodules css - lists the CSS modules that can be used for **debugging**
crsctl lsmodules crs - lists the CRS modules that can be used for **debugging**
crsctl lsmodules evm - lists the EVM modules that can be used for **debugging**

Exercise: Managing clusterware with crsctl

- Connect to rac11gtst1 or rac11gtst2 as user grid
- Check status of clusterware modules
  $ crsctl check cluster -all
  $ crsctl status resource -t –init
  $ crsctl check crs
  $ crsctl check css
  $ crsctl check evm
  $ crsctl query css votedisk

Managing Resources with srvctl

- The srvctl utility is a command-line tool that manages Oracle resources configured in the cluster
- In Oracle 11*g*R1 and earlier, srvctl managed six object types: asm, database, instances, services, node applications, and listeners.
- Oracle 11*g*R2 adds an additional ten object types: GNS, VIP Addresses, SCAN VIP addresses, SCAN listeners, Oracle homes, OC4J, servers, server pools, ASM disk groups, and ASM file systems.
- The same options are available in Oracle 11*g*R2 that were available in previous releases: enable, disable, start, stop, relocate, status, add, remove, modify, config, getenv, setenv, and unsetenv

Managing Resources with srvctl

	enable	disable	start	stop	relocate	status	add	remove	modify	config	getenv	setenv	unsetenv
database	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
instance	✓	✓	✓	✓		✓	✓	✓	✓				
service	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
nodeapps	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
vip	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓
asm	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
diskgroup	✓	✓	✓	✓		✓		✓					
listener	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓

Managing Resources with srvctl

	enable	disable	start	stop	relocate	status	add	remove	modify	config	getenv	setenv	unsetenv
scan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
scan_listener	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
srvpool						✓	✓	✓	✓	✓			
server					✓	✓							
oc4j	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
home			✓	✓		✓							
filesystem	✓	✓	✓	✓		✓	✓	✓	✓	✓			
gns	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			

Managing Resources with srvctl

- In Oracle 11.1 and earlier, you could stop an ASM instance, which resulted in a dismount command and a shutdown of the instance.
- In Oracle 11.2 the srvctl stop asm command does not work, especially if voting disks and OCR are located in ASM itself.
- To stop ASM in Oracle RAC 11.2, you need to shut down all clients of ASM, including CSSD.
- The only way to do this is to stop the High Availability Services stack on the node.
- The same applies to the srvctl stop home command when the Oracle home is the ASM home

Managing Resources with srvctl

- Useful command to know is srvctl's config option.
- This option retrieves information about a system, reporting all database resources if no additional arguments are provided.
- If an object such as a database, asm, scans, or scan listener is passed, then this option provides detailed information about the specified resource.
- For example, you could use the following to find out which IP addresses are used for the SCAN:
  $ srvctl config scan

Managing Resources with srvctl

- The srvctl stop home command simplifies patching the RDBMS.
- This command records which resources are currently started from the current node.
- This information is stored in a state file that the administrator specifies.
- Upon patch completion, you can use the srvctl start home command when the Grid Infrastructure restarts, and then use the state file and all resources that were active before the patch application is brought online again.

Exercise: Managing clusterware with srvctl

- Connect to server rac11tst1 or rac11gtst2 as user oracle
- Check statuses of different modules with:

```
$ srvctl status server -n rac11gtst1,rac11gtst2
$ srvctl status nodeapps
$ srvctl config nodeapps
$ srvctl status asm -a –v
$ srvctl config asm –a
$ srvctl status listener
$ srvctl config listener
$ srvctl config scan
$ srvctl status scan
$ srvctl config scan_listener
$ srvctl status scan_listener
$ srvctl config database -d rconv -a –v
$ srvctl status database -d rconv -v
```

Verifying the Cluster with the CVU

- The Cluster Verification Utility (CVU) is a command-line tool that was introduced in Oracle 10*g*R2.
- The CVU checks the configuration of a cluster and reports whether each component is successfully configured.
- The CVU checks operating system versions and patches, kernel parameters, user limits, operating system groups and users, secure shell configuration, networking configuration, and shared storage devices.
- The CVU can be invoked at a number of stages during the installation and configuration process
- The CVU should also be run following the completion of administrative tasks, such as node addition and deletion

Stages at which to Execute the cluvfy Utility

Stage description	Before	After
After hardware and operating system configuration		-post hwos
CFS setup	-pre cfs	-post crs
CRS installation	-pre crsinst	-post crsinst
HA configuration	-pre hacfg	-post hacfg
Before database installation	-pre dbinst	
ACFS configuration	-pre acfscfg	-post acfscfg
Before database configuration	-pre dbcfg	
Node addition	-pre nodeadd	-post nodeadd

The CVU Component Checks

Component	Description
nodereach	Reachability between nodes
nodecon	Node connectivity
cfs	Cluster file system integrity
ssa	Shared storage accessibility
space	Space availability
sys	Minimum space requirements
clu	Cluster manager integrity
ocr	OCR integrity
olr	OLR integrity
ha	HA integrity
crs	CRS integrity

The CVU Component Checks

Component	Description
nodeapp	Node application existence
admprv	Administrative privileges
peer	Compares properties with peers
software	Software distribution
asm	ASM integrity
acfs	ACFS integrity
gpnp	GPNP integrity
gns	GNS integrity
scan	SCAN configuration
ohasd	OHASD integrity
clocksync	Clock synchronization
vdisk	Voting disk udev settings

Verifying the Cluster with the CVU

- The CVU is implemented as a set of Java classes.
- On Linux, the CVU can be executed using the
- runcluvfy.sh shell script.
- After the installation has completed, the cluvfy file can be found in $GRID_HOME/bin
- The default form of the command includes a list of nodes that should be checked.
- For example, the following snippet verifies the configuration of the hardware and the operating system on nodes london1 and london2:
  $ cluvfy stage -pre hwos -n london1,london2
- You can append the –verbose switch to generate more detailed output

Verifying the Cluster with the CVU

- In Oracle 11*g*R2 and later, the CVU can optionally generate fixup scripts to resolve a limited subset of errors.
- In Linux, fixup scripts can be generated to adjust kernel parameters and modify user limits.
- The resulting scripts must be executed by the root user.
- The CVU must be executed by a regular user (e.g., grid or oracle; it cannot be executed by the root user).

Exercise: Managing Clusterware with CVU

- Connect to rac11gtst1 or rac11gtst2 as user grid
- Check prerequisites to configure database:
  $ cluvfy stage -pre dbcfg -n rac11gtst1,rac11gtst2 -d /u01/app/oracle/product/11.2.0/db_1
- List of components that you can check with cvu
  $ cluvfy comp -list –help
  $ cluvfy comp ocr –verbose
  $ cluvfy comp vdisk –verbose
- Check some of the components of your choice with cluvfy

Configuring Network Interfaces with oifcfg

- The Oracle Interface Configuration Tool (oifcfg) is a command-line tool that can be used to configure network interfaces within Oracle Clusterware.
- The oifcfg utility can be used to add new public or private interfaces, as well as to modify existing subnet information.
- Prior to Oracle 11*g*R2, oifcfg updated the OCR only. In Oracle 11*g*R2, oifcfg has been extended to update the OLR and the GPNP profile.

Exercise: Managing Clusterware with oifcfg

- Connect to rac11gtst1 or rac11gtst2 as user grid
- Check your Clusterware network configuration with:
  $ oifcfg getif –global
  $ oifcfg iflist -p -n

Administering the OCR and OLR with ocrconfig

- The Oracle Cluster Registry Configuration tool ocrconfig is a command-line utility that can be used to administer the OCR and OLR.
- The ocrconfig tool has a number of options, including the ability to add and delete OCR mirrors, perform manual backups of the OCR, restore OCR backups, and export and import OCR configuration data.
- Many of the options for ocrconfig are also applicable to maintaining the OLR; options that target the OLR use the -local switch.

Administering the OCR and OLR with ocrconfig


```
$ ocrconfig -help
Name:
ocrconfig - Configuration tool for Oracle Cluster Registry.
Synopsis:
ocrconfig [option]
option:
-export <filename> [-s online]
- Export cluster register contents to a file
-import <filename>
- Import cluster registry contents from a file
-upgrade [<user> [<group>]]
- Upgrade cluster registry from previous version
-downgrade [-version <version string>]
- Downgrade cluster registry to the specified version
-backuploc <dirname> - Configure periodic backup location
-showbackup - Show backup information
-restore <filename> - Restore from physical backup
-replace ocr|ocrmirror [<filename>]
-   Add/replace/remove a OCR device/file
-overwrite - Overwrite OCR configuration on disk
-repair ocr|ocrmirror <filename> - Repair local OCR configuration
-help - Print out this help information
```

Exercise: Managing Clusterware with ocrconfig

- Connect to rac11gtst1 or rac11gtst2 as user grid
- Show OCR backups with:
  $ ocrconfig –showbackup
- Export OCR contents to file with:
  $ ocrconfig –export ractst.ocr
- Connect to rac11gtst1 or rac11gtst2 as user root
- Export OCR contents with:
  # cd /u01/11.2.0/grid/bin
  #./ocrconfig –export /root/ractst.ocr
- Check contents of OCR export with:
  # strings /root/ractst.ocr|more
- Backup OCR manually with:
  # ./ocrconfig –manualbackup
  # ./ocrconfig -showbackup

Checking the State of the OCR and its Mirrors with ocrcheck

- The Oracle Cluster Registry Check tool, ocrcheck, checks the state of the OCR and its mirrors.
- The behavior of ocrcheck is determined by the user that invokes it.
- When invoked by a regular user, such as grid or oracle, ocrcheck checks the accessibility of all OCR mirror copies.
- It also reports on the current size and free space in the OCR.
- When invoked by the root user, ocrcheck also performs a structural check on the contents of the OCR and reports any errors.
- The ocrcheck command is most useful when trying to determine logical corruption in the OCR.

Exercise: Managing Clusterware with ocrcheck

- Connect to rac11gtst1 or rac11gtst2 as user grid
- Show OCR configuration with:
  $ ocrcheck –config
- Check OCR with:
  $ ocrcheck
- Connect to rac11gtst1 or rac11gtst2 as user root
- Check OCR with:
  $ ocrcheck
- What is the difference between those two checks?

Dumping Contents of the OCR with ocrdump

- The Oracle Cluster Registry Dump tool, ocrdump, can be used to dump the contents of the OCR to a text or XML file.
- ocrdump can only be executed by the root user.
- If requested, ocrdump can also dump the OLR to a file.
- The dump file name will default to OCRDUMP; however, this name can be changed by specifying an alternative file name on the command line.

Dumping Contents of the OCR with ocrdump

- If desired, ocrdump can write to standard output.
- A very useful option is to extract the contents of a backed up OCR or OLR.
- This enables you to perform before and after comparisons when applying patchsets, for example.
- If you are unsure where your backup files are located, consult the output of ocrconfig -showbackup [-local].
- For very specific troubleshooting needs, ocrdump offers the option to print only a specific key from the registry.

Exercise:
Managing Clusterware with ocrdump

- Connect to rac11gtst1 or rac11gtst2 as user root and change directory to:
  # cd /u01/11.2.0/grid/bin
- Dump OCR to text file
  # ./ocrdump /root/ractst.txt
- Dump OCR to xml file
- # ./ocrdump /root/ractst.xml
- View contents of text and xml dump files

CLSCFG

- Another useful but poorly documented 11g Clusterware tool is the Clusterware configuration tool or CLSCFG.
- This utility provides a host of features for managing and updating your Oracle 11g RAC Clusterware configurations, allowing you to perform the following administration tasks for the Oracle 11g Clusterware:
  - Creating a new 11g Clusterware configuration
  - Upgrading existing Clusterware
  - Adding or removing nodes from the current 11g Clusterware

CLSCFG

- Another nifty feature of the CLSCFG utility is to provide basic self documentation and self help on the Oracle 11g Clusterware environment, by using the concepts parameter for the clscfg utility as shown here:

```
$ clscfg -concepts
```

Exercise: Managing Clusterware with clscfg

- Connect to rac11gtst1 or rac11gtst2 as user grid
- View Clusterware concepts with:
  $ clscfg -concepts

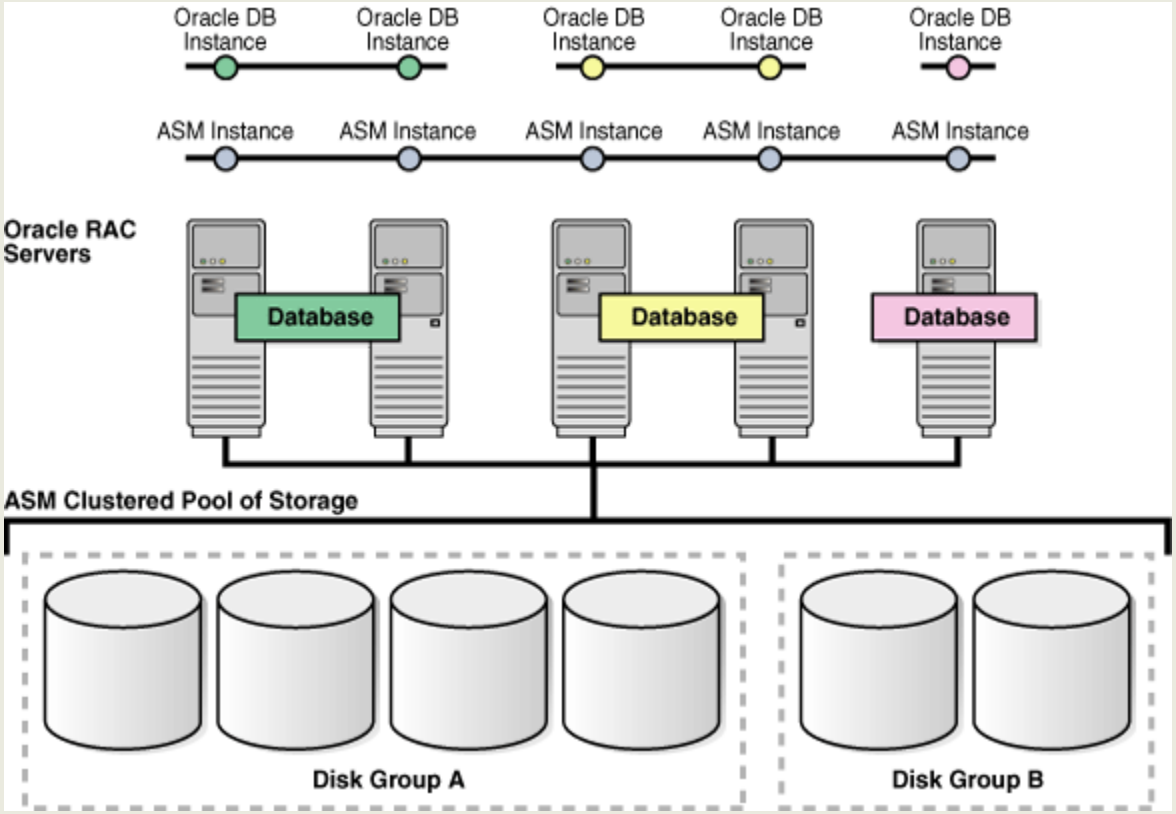
Maintaining Automatic Storage Management

- Oracle Automatic Storage Managenment (ASM) concepts
  - Instances,
  - disk groups,
  - disks,
  - files
- Tools for ASM maintenance:
  - Enterprise Manager
  - ASMCA – ASM Configuration Assistant
  - ASMCMD – command line utility

ASM concepts

- ASM is a volume manager and a file system for Oracle database
- supports single-instance and RAC Oracle Database configurations
- ASM uses disk groups to store data files;
- ASM disk group is a collection of disks that Oracle ASM manages as a unit.
- Within a disk group, ASM exposes a file system interface for Oracle database files
- You can add or remove disks from a disk group while a database continues to access files from the disk group
- ASM volume manager functionality provides flexible server-based mirroring options
- ASM uses the Oracle Managed Files (OMF) feature to simplify database file management

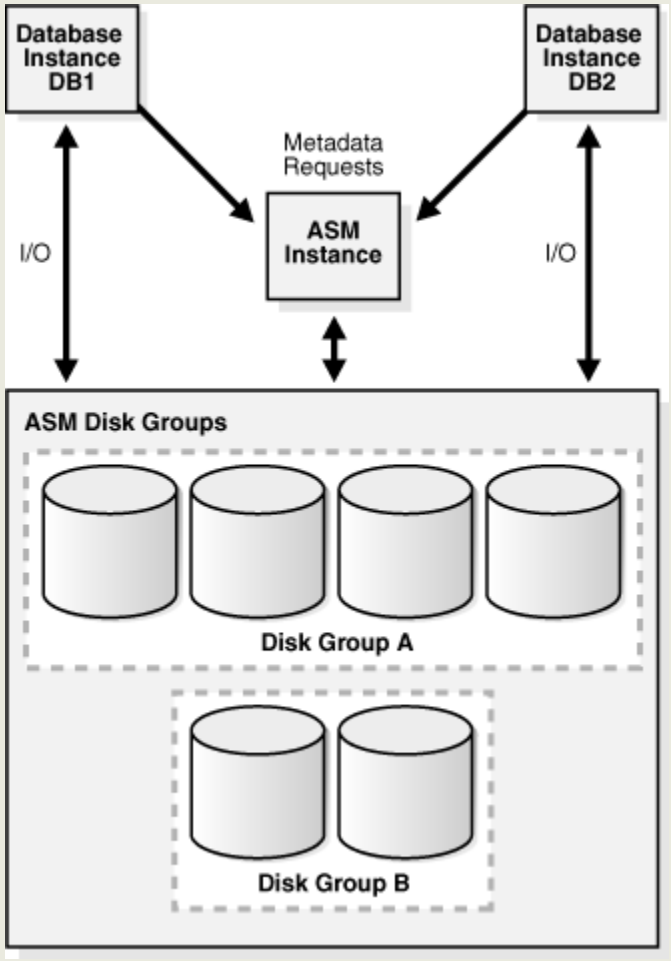
ASM Concepts



ASM concepts

- ASM Instances
  - A separate ASM instance must be running on each node in a RAC cluster.
  - The ASM instance maintains metadata in the ASM disk groups and supports with the database instances.
  - The ASM instance must be started before database instances can access files located in ASM storage.
  - If the ASM instance is terminated, all client database instances will also be terminated.
  - The ASM instance also handles adding and dropping disks and rebalancing operations,
  - The database instance communicates with the ASM instance to obtain information about files stored in ASM.
  - The ASM instance does not perform I/O directly for applications.
  - Application I/O is still performed by the server processes and background processes associated with the database instances.
  - The ASM instance performs I/O only during rebalancing operations

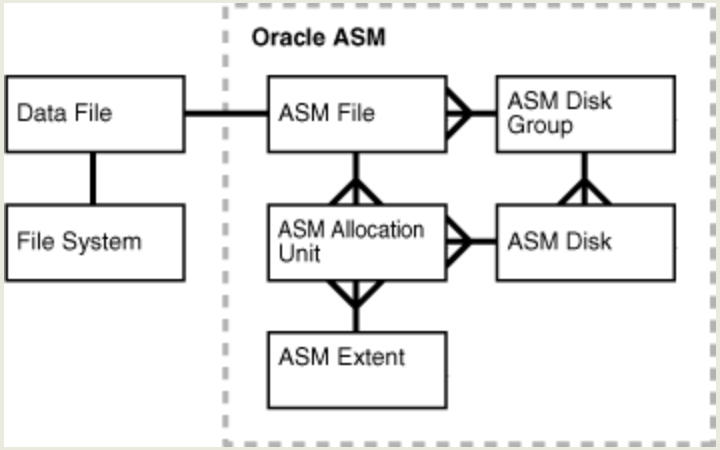
ASM concepts



ASM concepts

- A disk group is a logical container for one or more ASM disks and is the highest level of data structure in ASM
- The disk group can be used to place various database file types, such as datafiles, online redo, archivelogs, RMAN backupsets, OCR and Voting disks (in 11g R2)
- when a datafile is created in a disk group, the datafile extents are striped/ distributed evenly across the available disks of the disk group
- you can also set the following specified mirroring level at the disk group to protect the data integrity
  - External redundancy: Relies on the STORAGE (RAID)-level mirroring redundancy option to protect the data
  - Normal redundancy: Provides a default two-way mirroring option
  - High redundancy: Provides a three-way mirroring redundancy option of ASM files

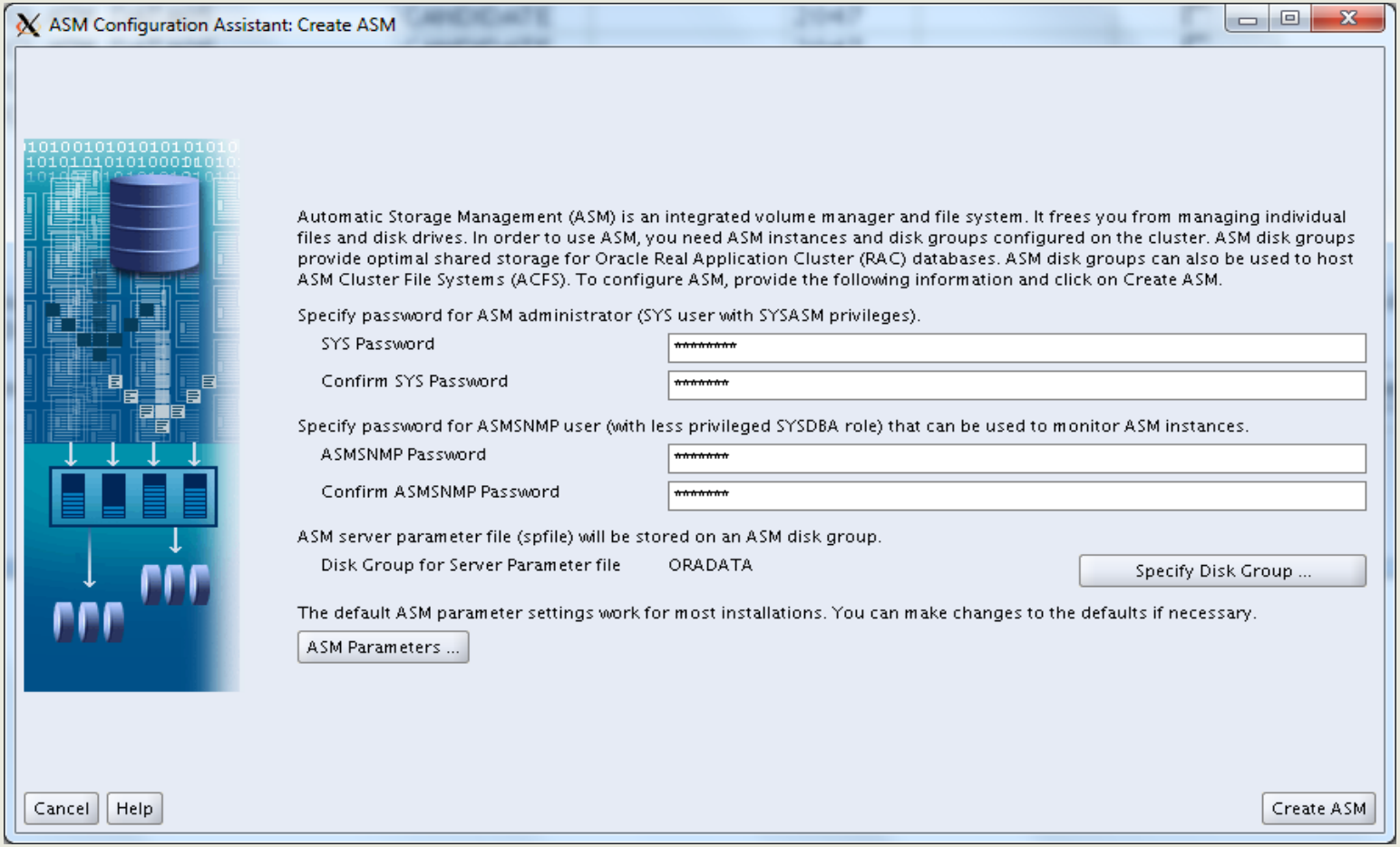
ASM concepts



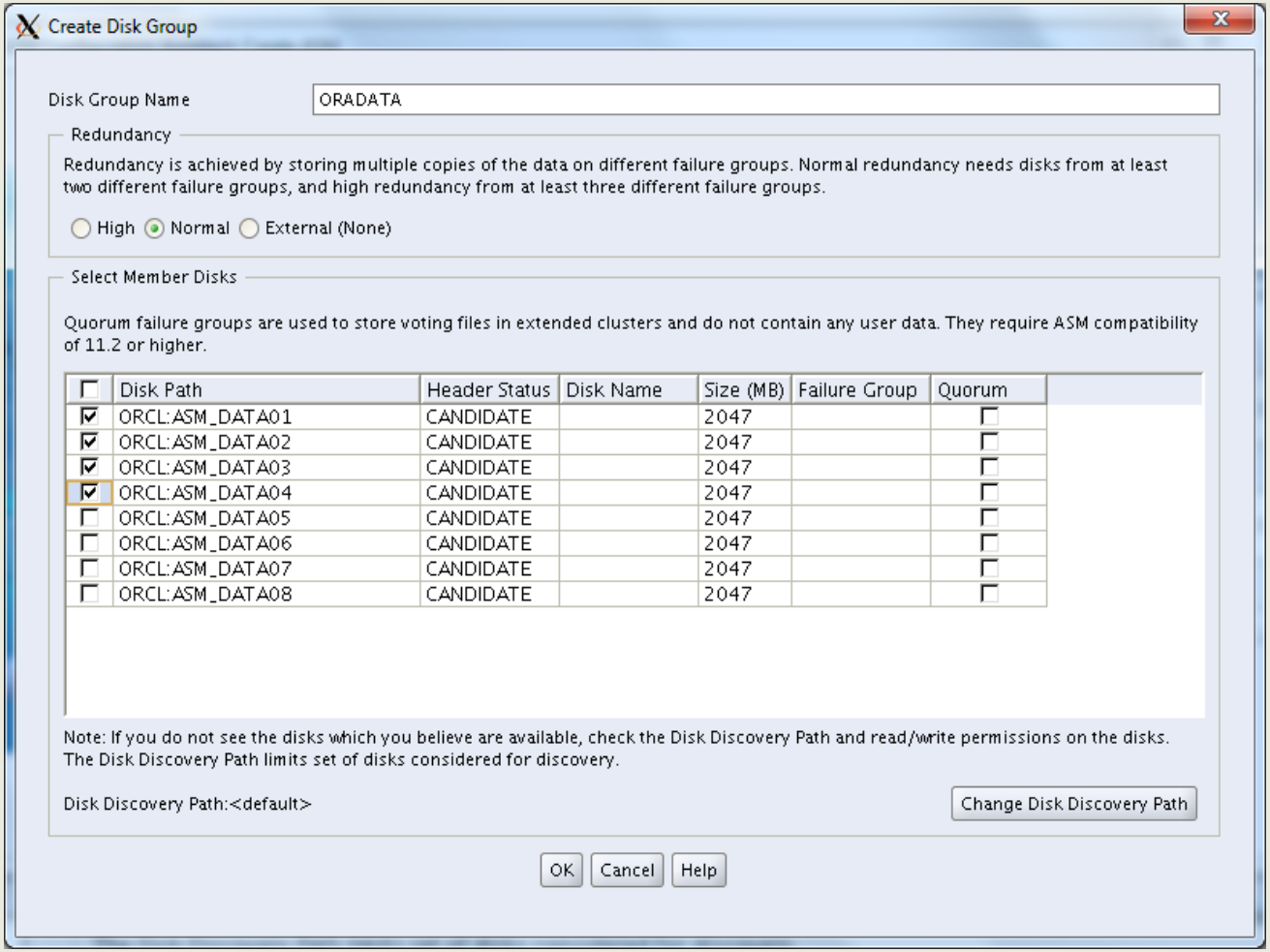
Creating ASM instance

- You can create an ASM instance initially using various methods: manual, interactive GUI tools such as DBCA (in 11g R1), ASMCA (from 11g R2 onwards), and Grid Control.

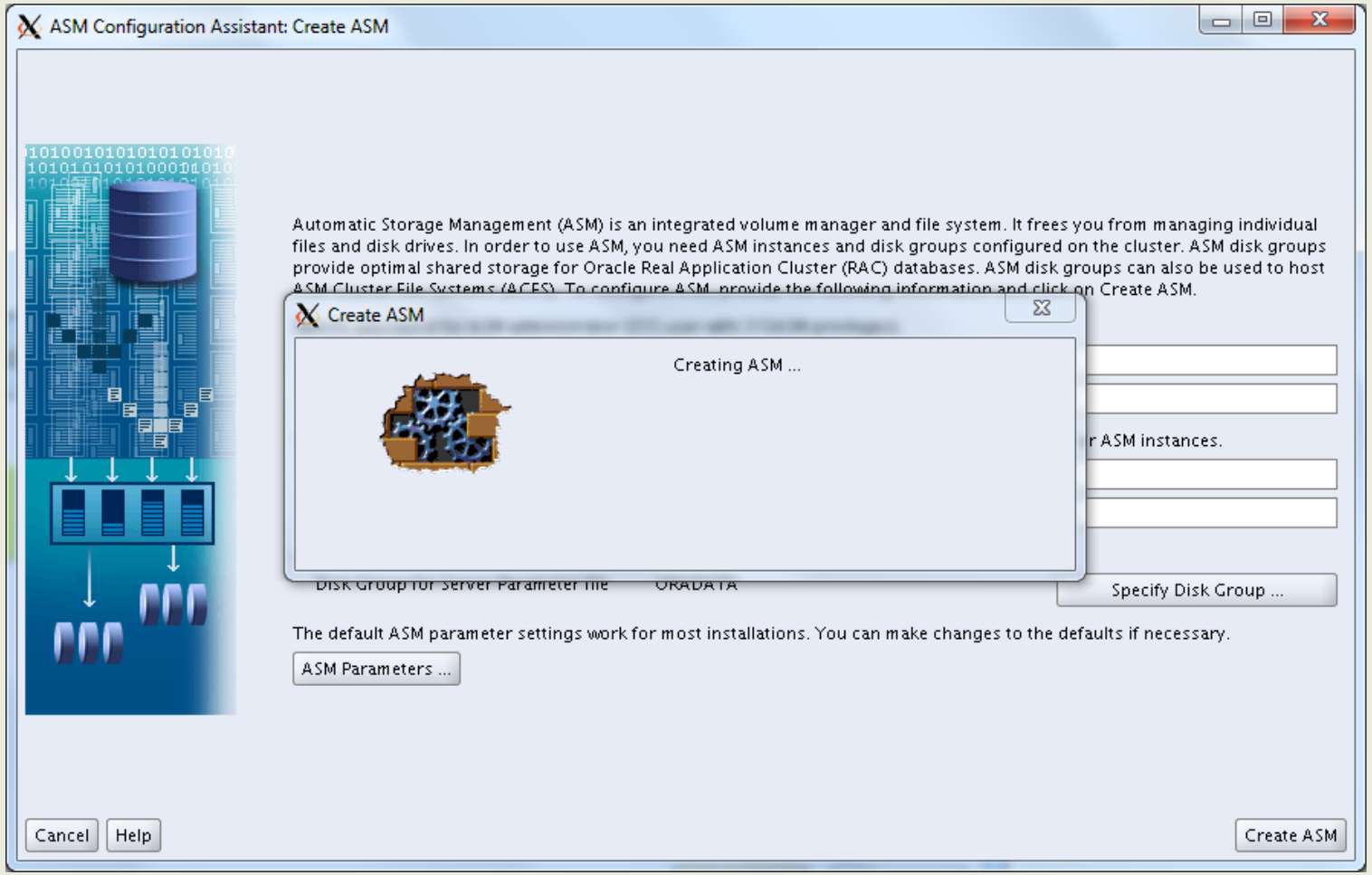
Creating ASM instance with ASMCA



Creating ASM instance with ASMCA



Creating ASM instance with ASMCA



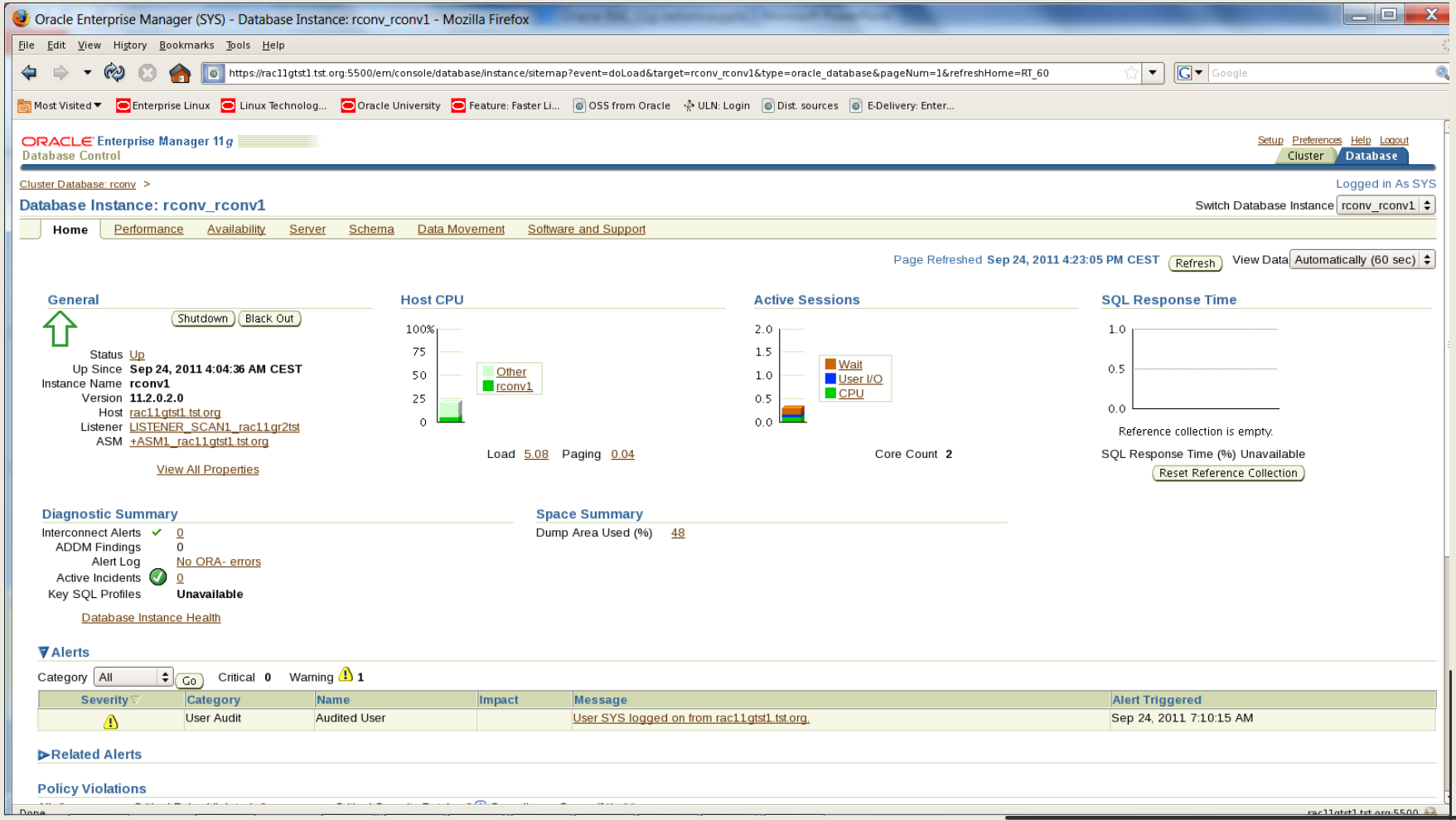
ASM instance startup/shutdown

- it is strongly recommended that you use the SRVCTL utility for managing the (start/stop) ASM instance in an RAC environment.
- To start asm instance on server raclinux1 you use command:
  $ srvctl start asm –n raclinux1
- To start asm instance on server raclinux1 you use command:
  $ srvctl start asm –n raclinux1

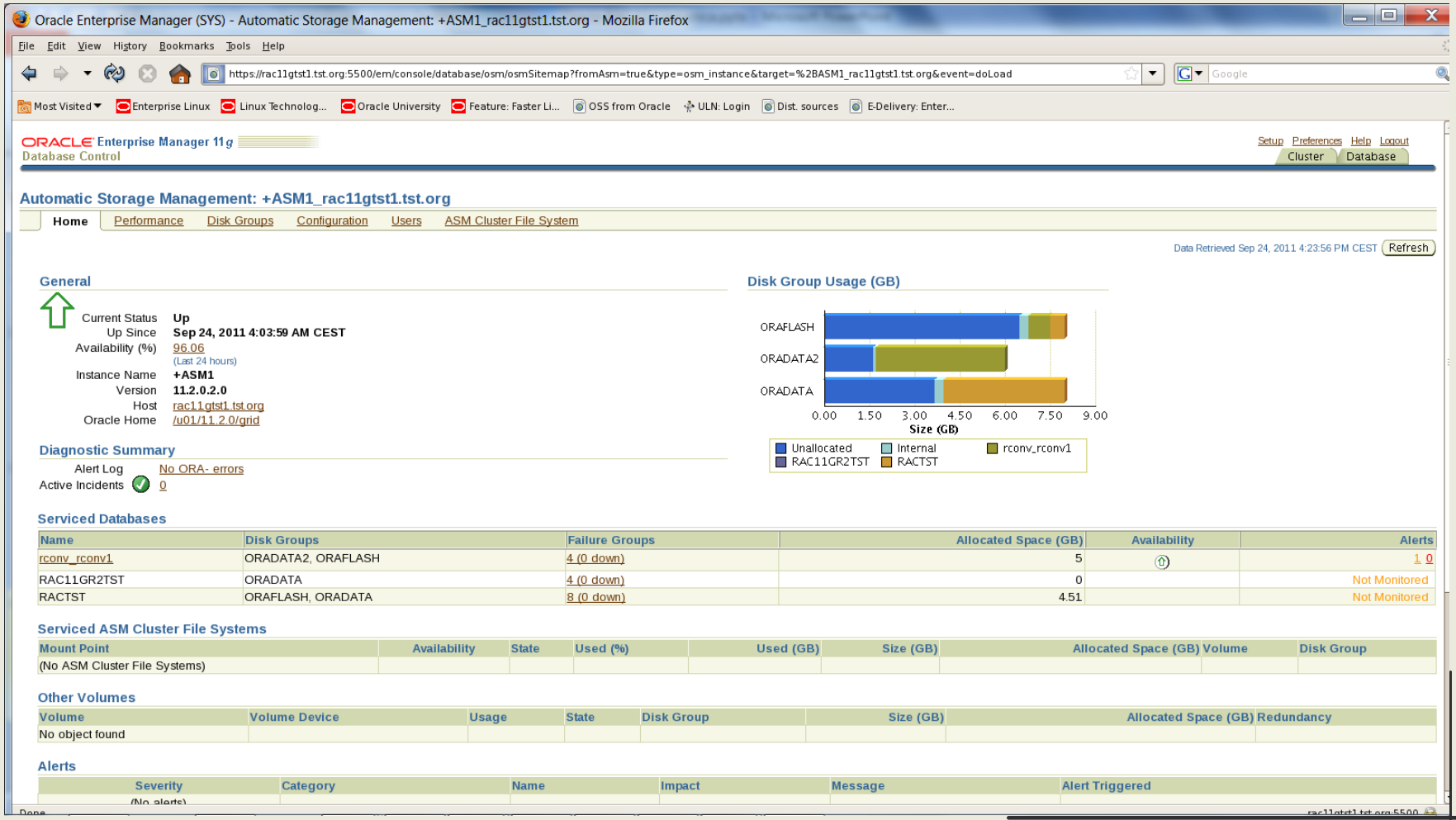
Exercise: Managing asm with srvctl

- Connect to server rac11gtst1 or rac11gtst2 as user oracle
- Check status of asm instances
  $ srvctl status asm –a –v
- Check configuration of asm instances
  $ srvctl config asm –a
- Check configuration of asm disk groups
  $ srvctl status diskgroup -g ORADATA –a
  $ srvctl status diskgroup -g ORADATA2 –a
  $ srvctl status diskgroup -g ORAFLASH –a
- Check status of listener
  $ srvctl status listener

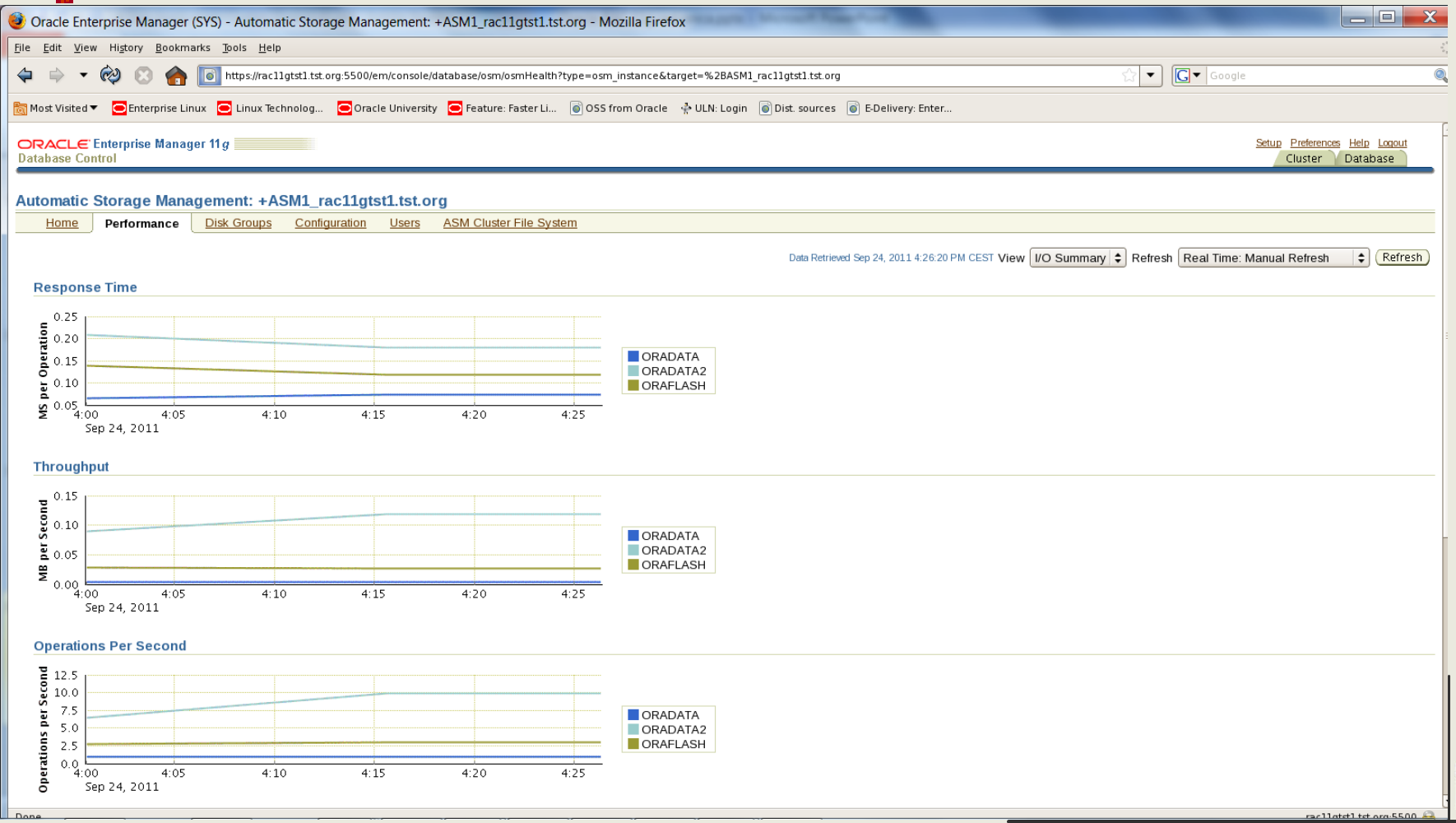
Managing ASM with Enterprise Manager



ASM instance Home page

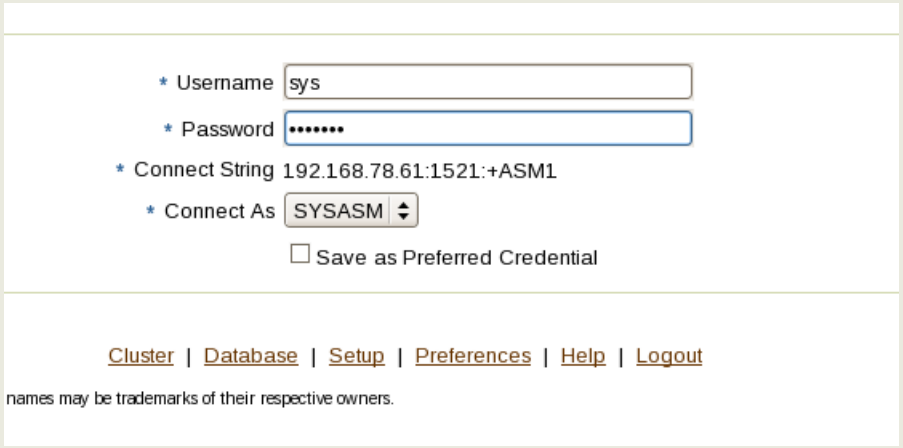


ASM instance Performance page

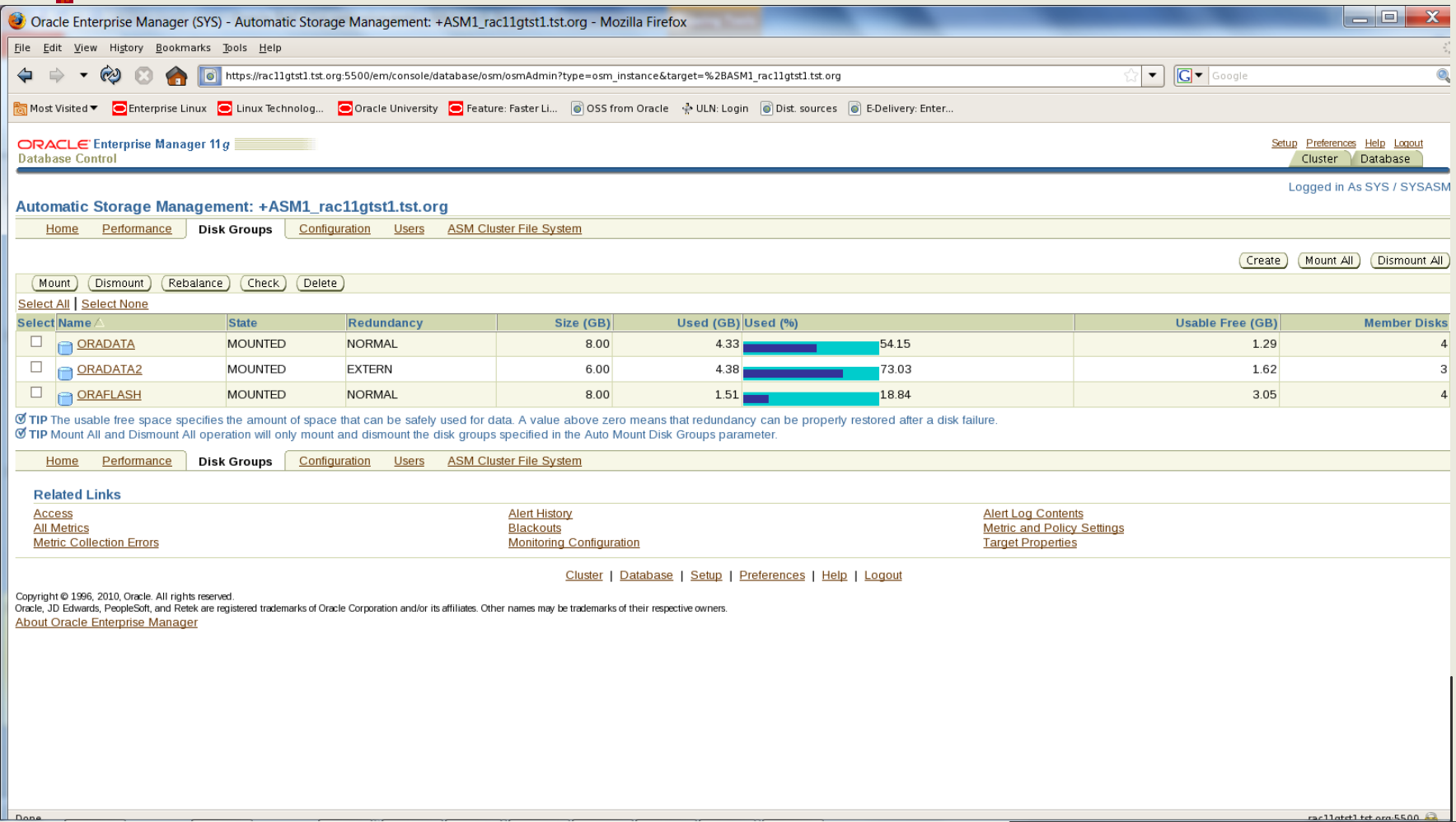


ASM instance
Disk Groups page

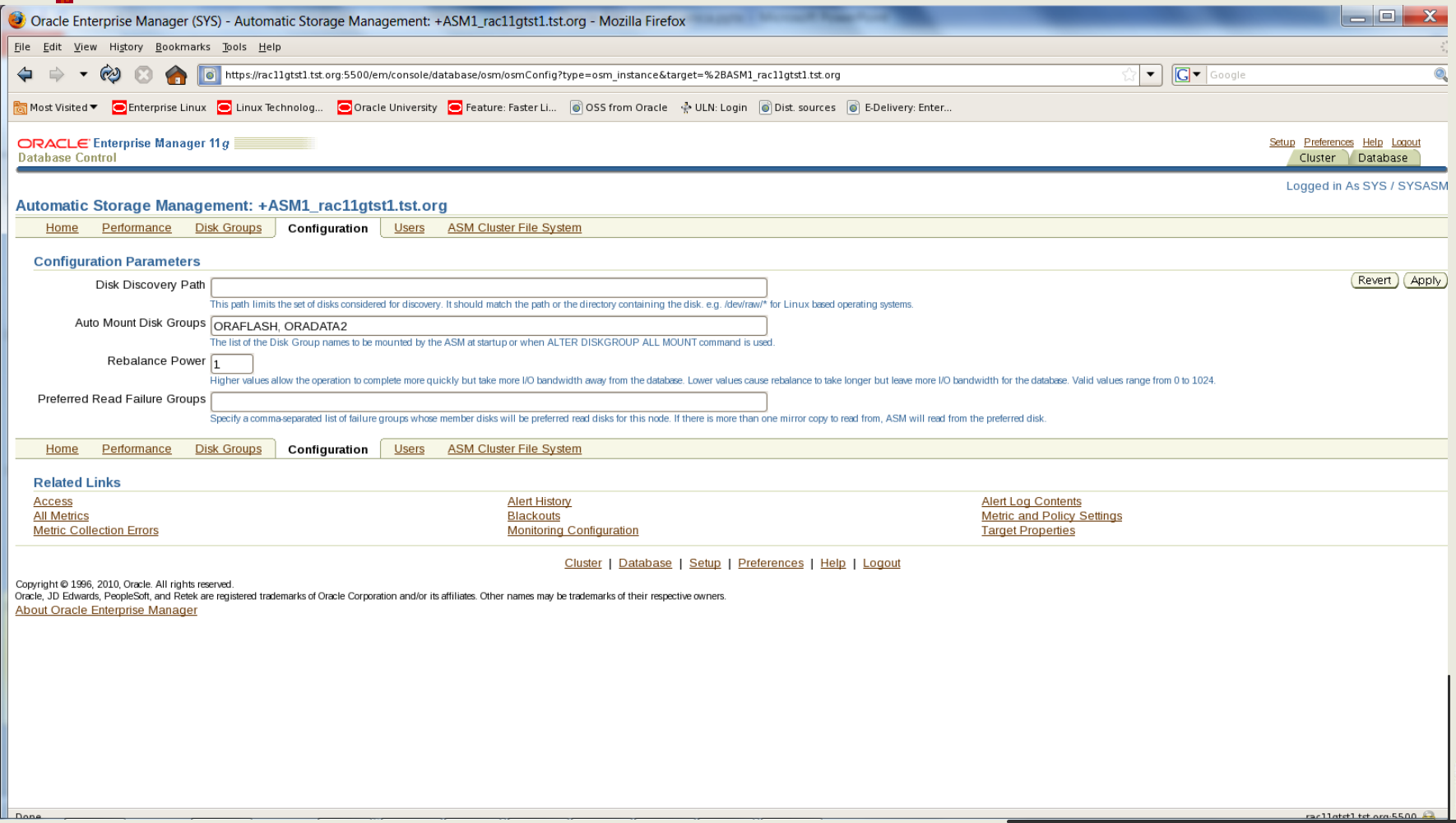
- To access disk groups page you must login to ASM instance with user sys



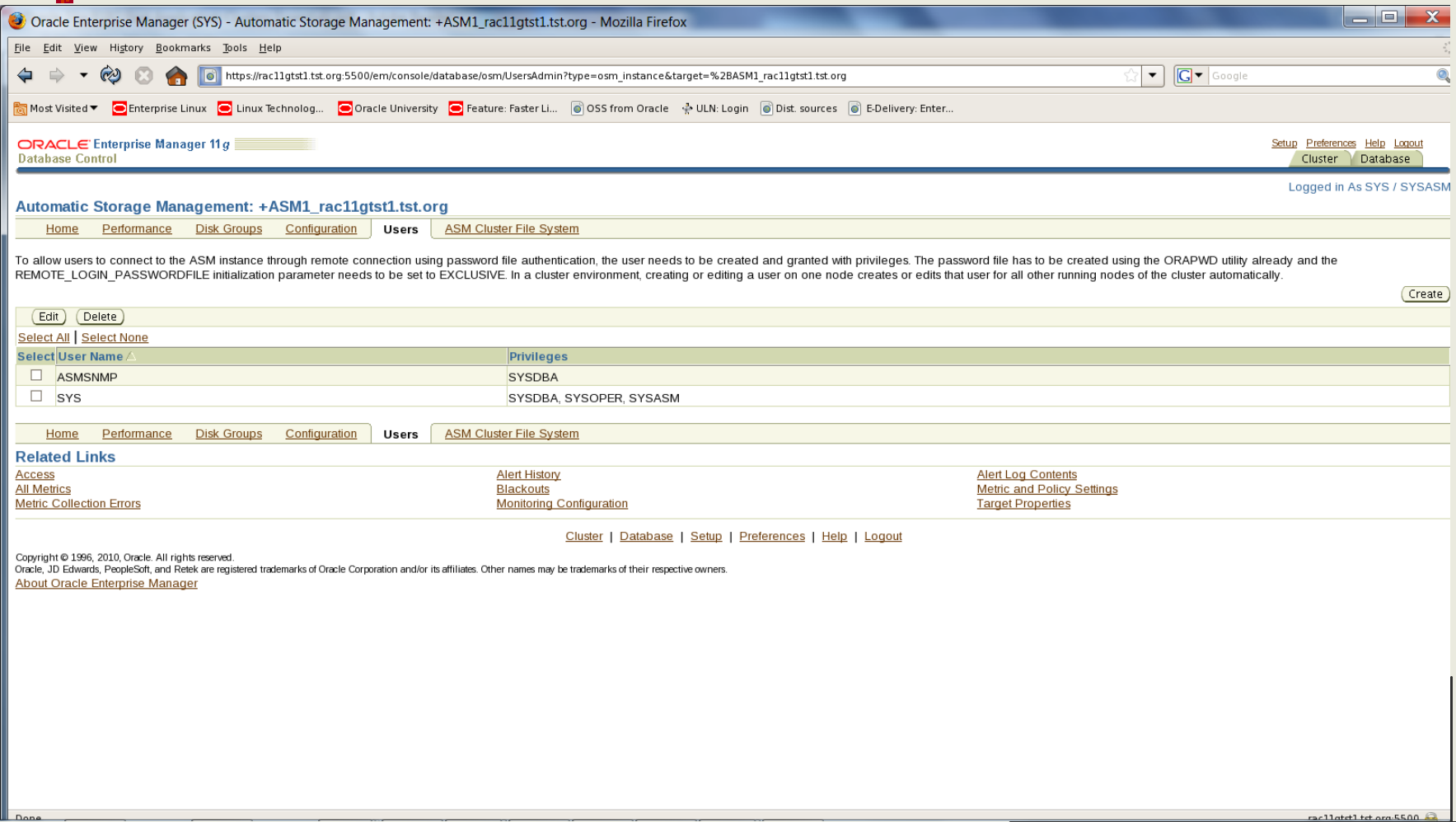
ASM instance Disk Groups page



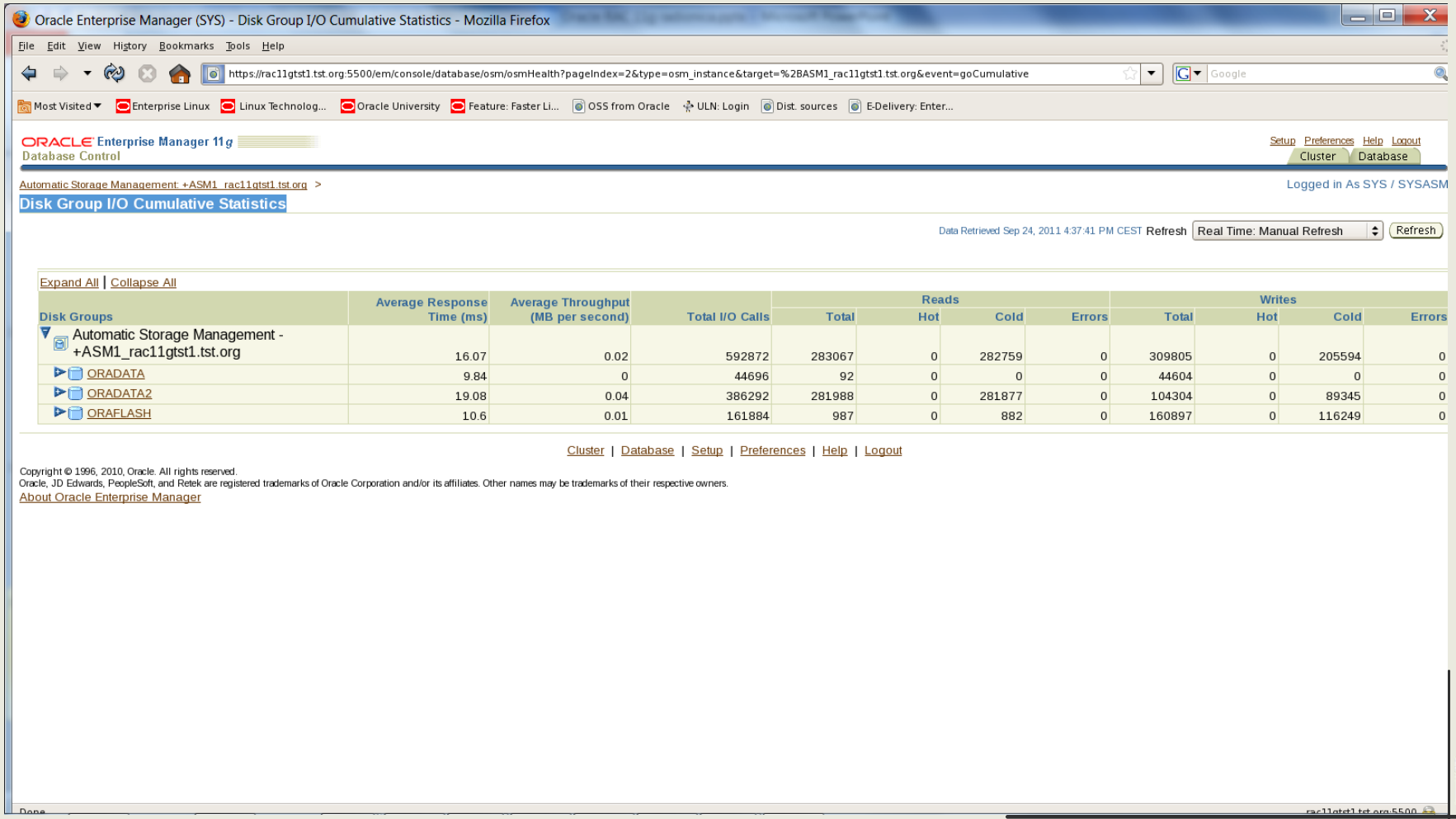
ASM instance Configuration page



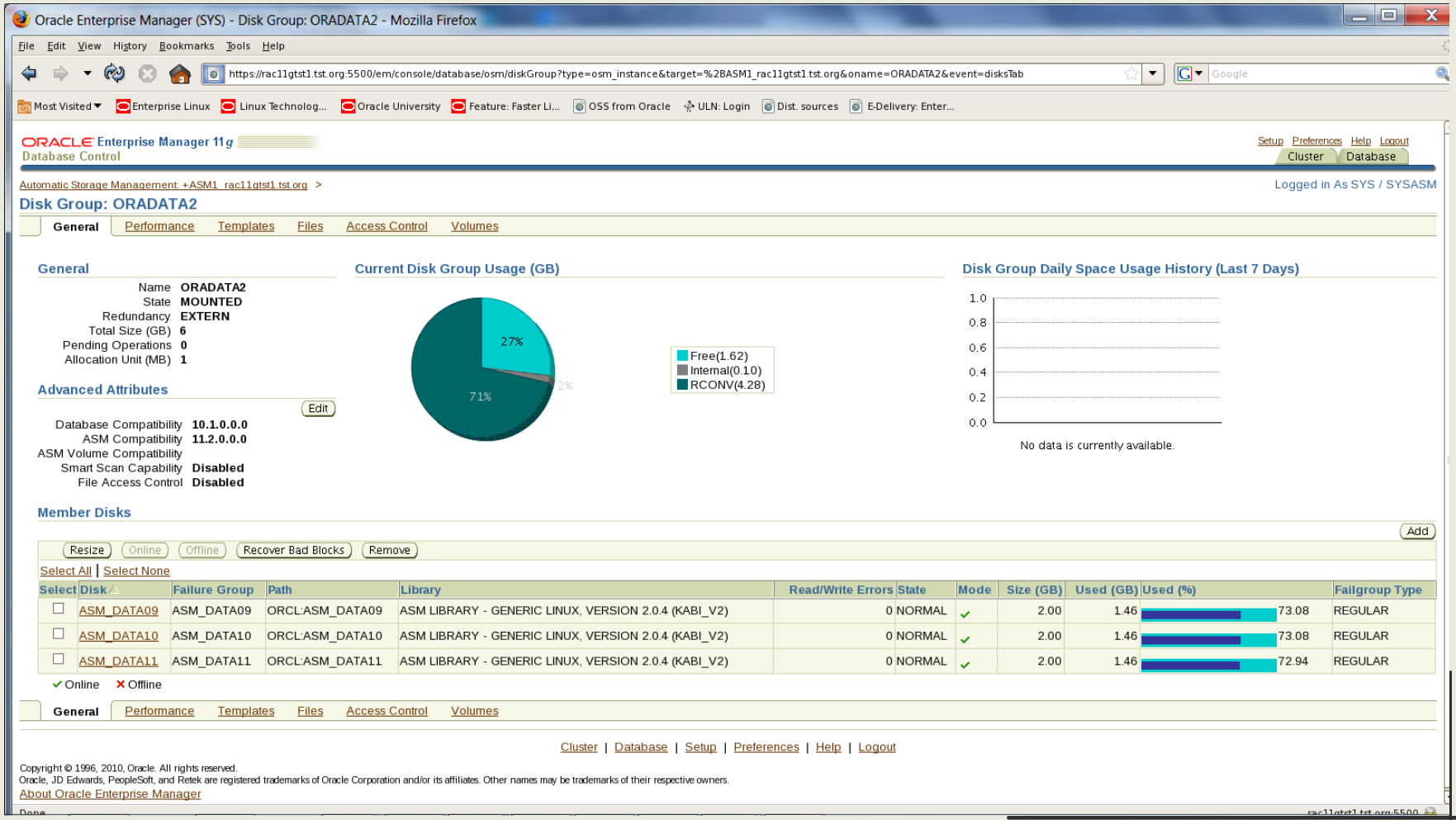
ASM instance Users page



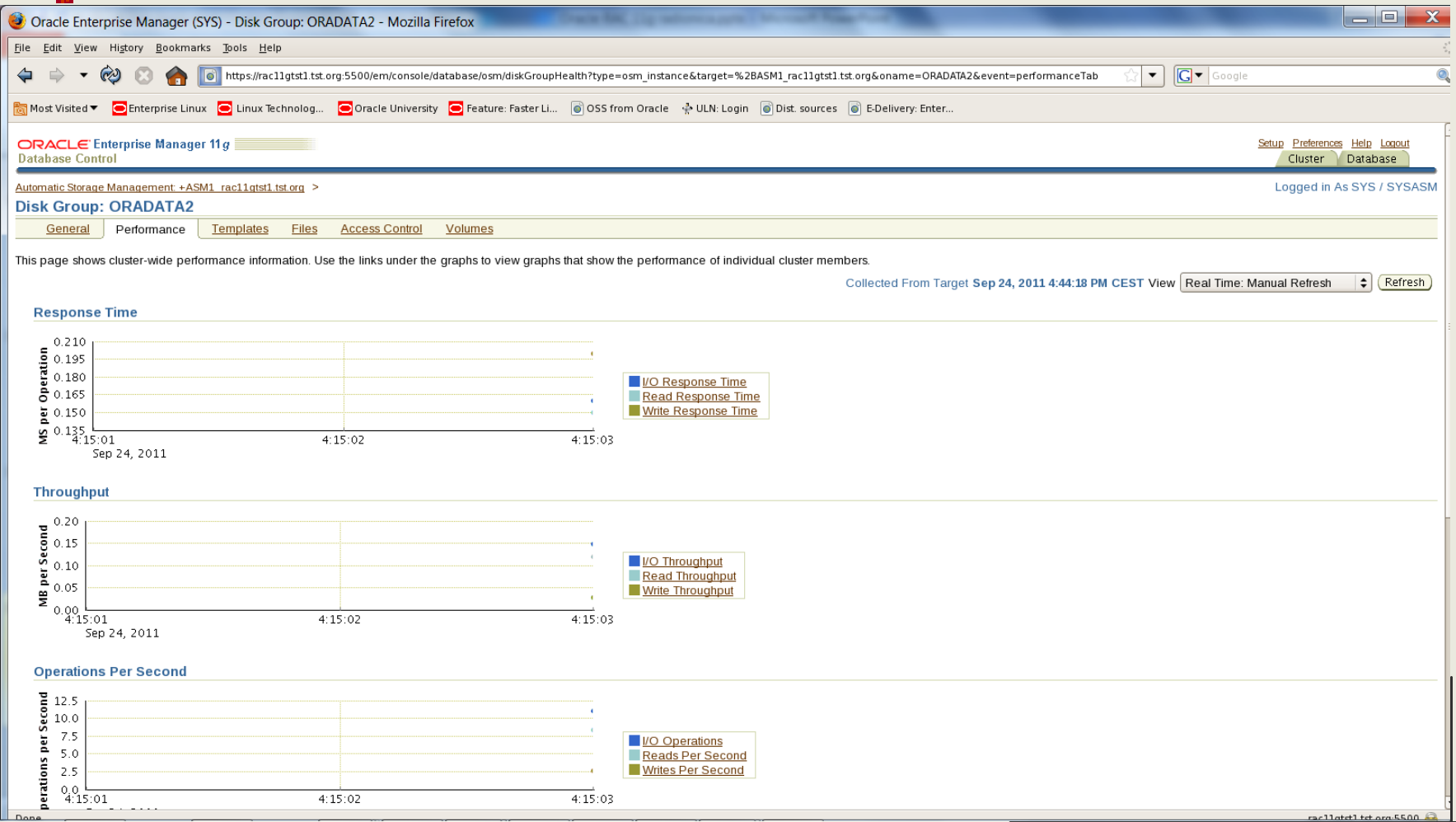
ASM instance Disk Group I/O Cumulative Statistics page



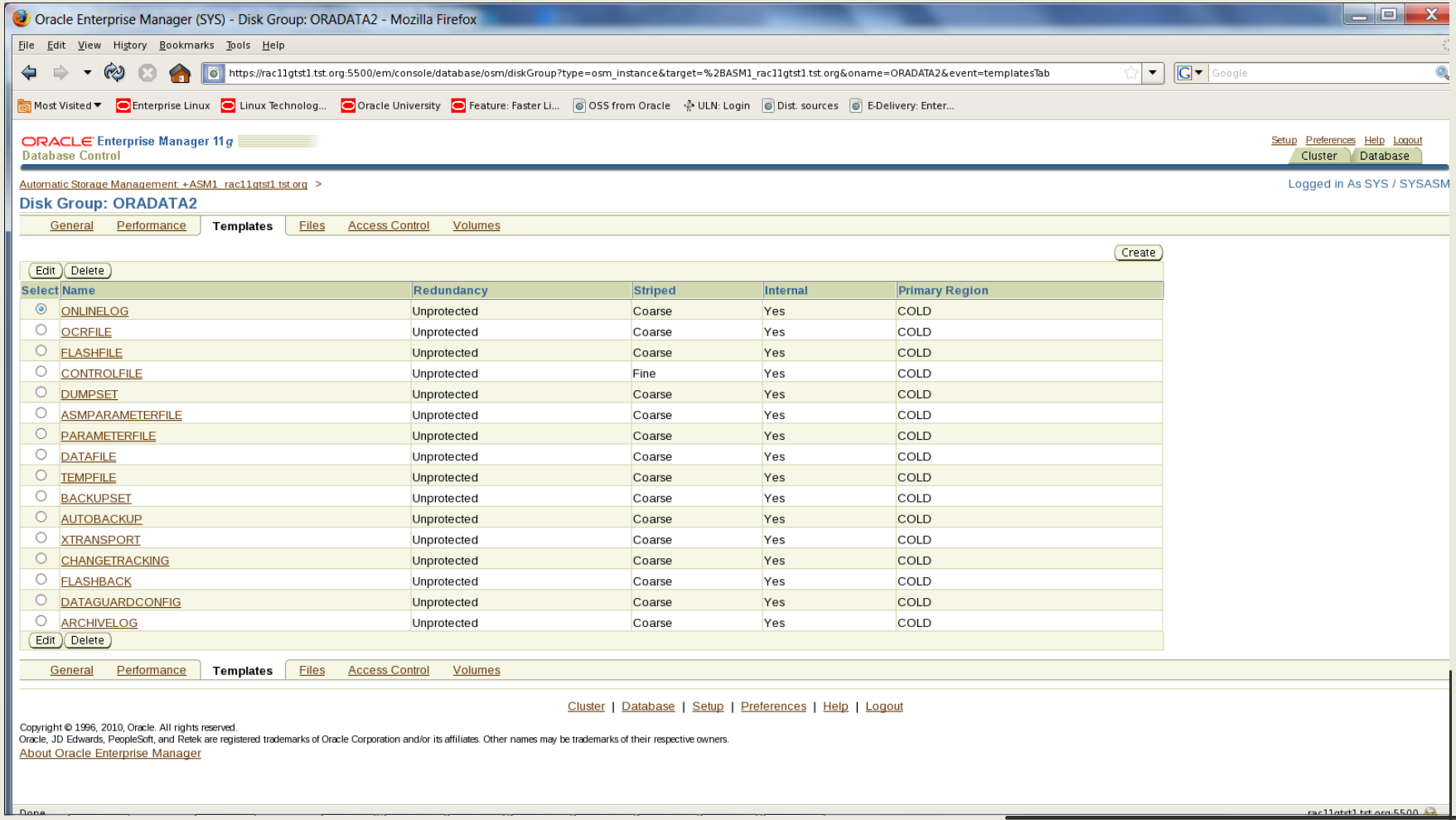
ASM disk group ORADATA2 General page



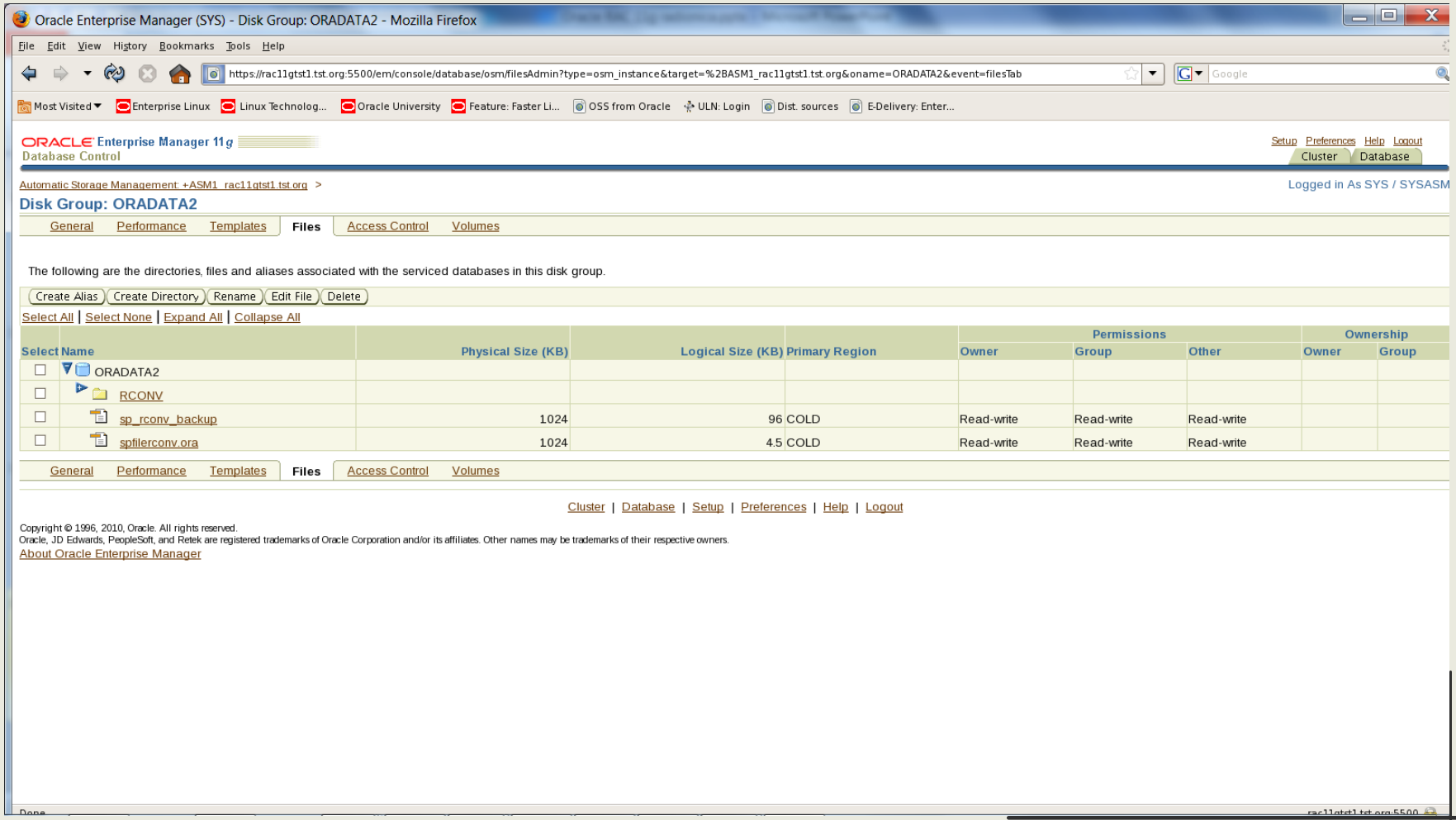
ASM disk group ORADATA2 Performance page



ASM disk group ORADATA2 Templates page



ASM disk group ORADATA2 Files page



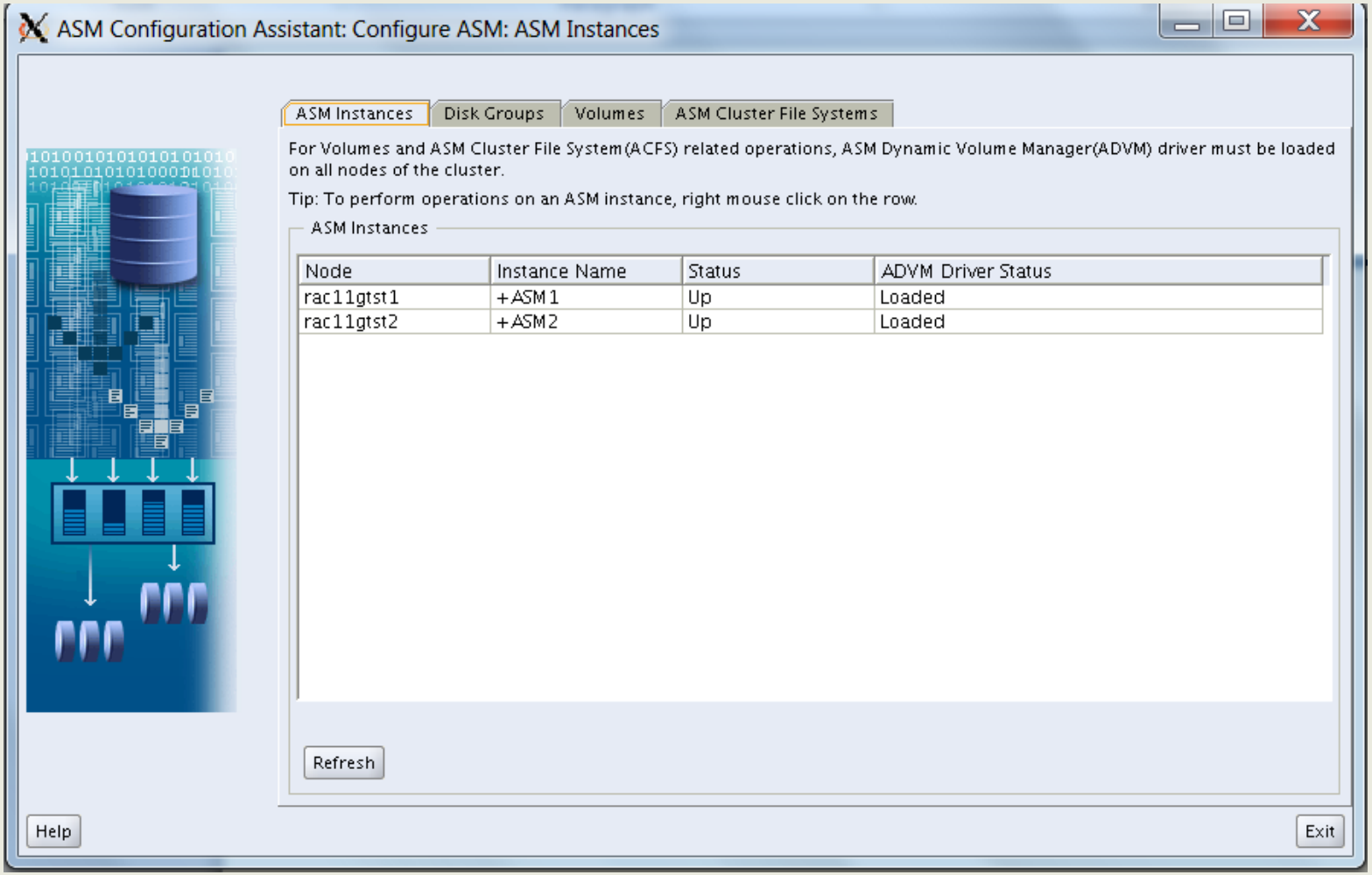
Exercise: Using Enterprise Manager ASM pages

- Connect to Enterprise Manager Database Control https://rac11gtst1:5500/em
- Navigate through ASM pages: Home, Performance, Disk Groups, Configuration, Users, Disk Group I/O Cumulative Statistics
- Navigate through ASM disk group OARADATA2 pages: General, Performance, Templates, Files

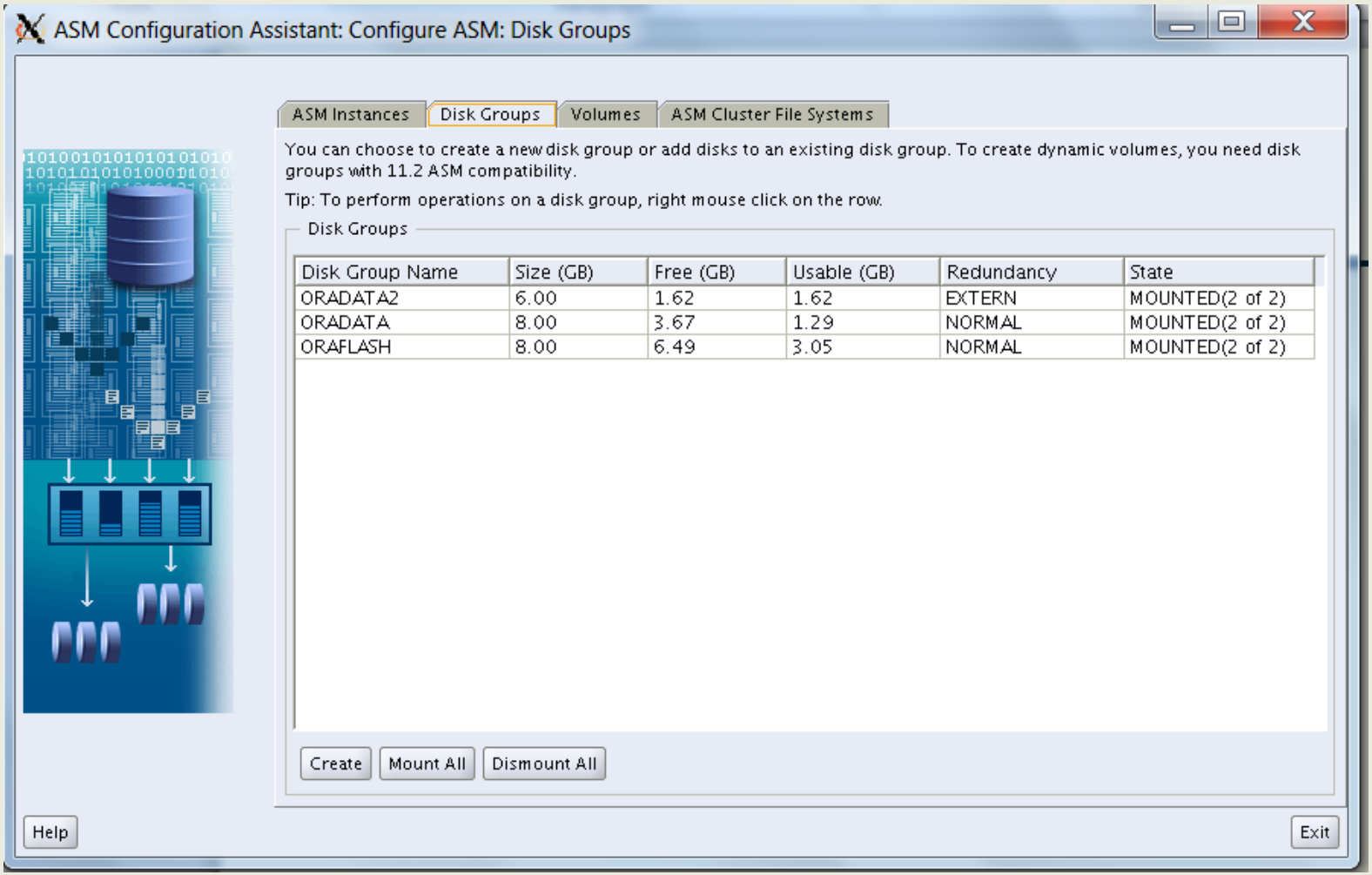
Managing ASM with ASM Configuration Assistant

- You must login to rac11gtst1 or rac11gtst2 as user grid
- To run asmca you should execute
  $ asmca

ASM Configuration Assistant ASM Instances



ASM Configuration Assistant Disk Groups



Exercise: Managing ASM with ASMCA

- Check status of ASM instances and disk groups with asmca