

Proactively Tuning Your Database Using the SQL Tuning Advisor

Purpose

This module describes how you can use Enterprise Manager and Automatic Workload Repository to proactively tune your database. Many of the analysis tools used by the Tuning Advisor are exposed, allowing the database administrator to perform reactive tuning as well.

Topics

This module will discuss the following topics:

- ☐ [Overview](#)
- ☐ [Prerequisites](#)
- ☐ [Viewing Database Waits](#)
- ☐ [Examining Top SQL for a Database Wait Class](#)
- ☐ [Tune a SQL Statement Using the SQL Tuning Advisor](#)
- ☐ [Reviewing SQL Execution Details for a SQL Statement](#)



Place the cursor on this icon to display all screenshots. You can also place the cursor on each icon to see only the screenshot associated with it.

Overview

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What are the new SQL Tuning and Diagnostics features of Enterprise Manager?

The Automatic Workload Repository collects, processes, and maintains performance statistics for problem detection and self-tuning purposes. The Automatic Database Diagnostic Monitor (ADDM) reduces the amount of effort required to diagnosis and tune Oracle systems. The SQL Tuning Advisor feature allows a quick and efficient technique for optimizing SQL statements.

Performance diagnostic information can be viewed in Oracle Enterprise Manager screens after diagnostic monitoring has completed on the data. When performance problems are encountered, you can launch Oracle advisors to further define and correct the problems. For example, ADDM can identify high load SQL statements, then you can tune these statements with the SQL Tuning Advisor.

Proactive versus Reactive Database Tuning

With the new integrated and automatic tuning features of the Oracle Database 10 g , you can use Enterprise Manager to detect problems as they occur and devise solutions for the tuning problems. As the DBA, you would simply implement the recommendations. This is referred to as Proactive Tuning.

You can also use the same tools to perform your own analysis of database performance. You can create SQL Tuning

Tasks to resolve problems in the method best suited for your business. This is referred to as Reactive Tuning.

Prerequisites

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Before starting this module, you should have:

1. Completed the [Configuring Linux for the Installation of Oracle Database 10g](#) lesson
2. Completed the [Installing the Oracle Database 10g on Linux](#) lesson
3. Download and unzip [perflab.tar](#) into your working directory (i.e. /home/oracle/wkdir)

Viewing Database Waits

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You will first initiate several workload sessions. Then you will investigate the database workload. Perform the following:

1. Open a command line window, and run the following OS script:

```
./
```

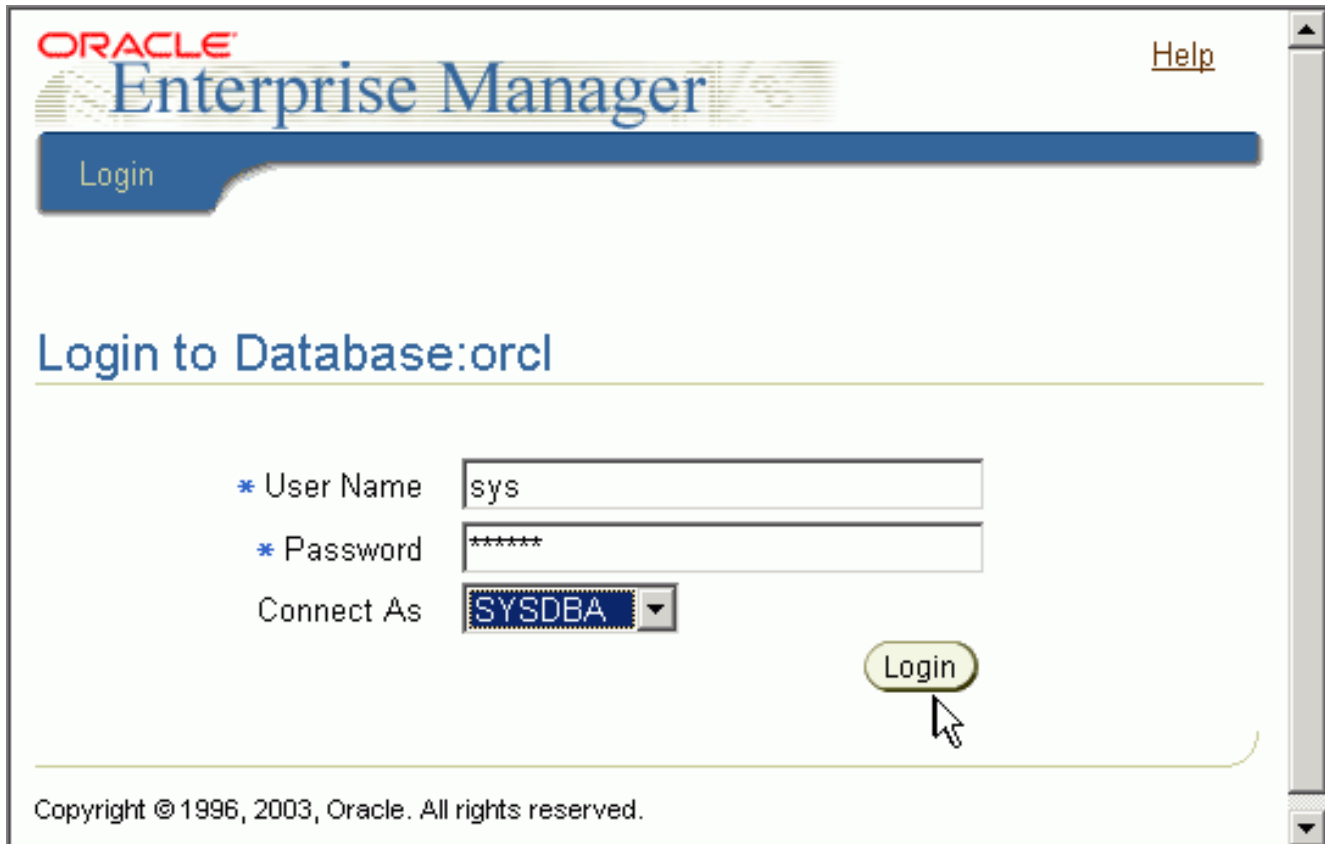
```
setup_perflab.sh
```

Note: This script will take approximately four minutes to run.

2. Open a browser and enter the following URL:

`http://<hostname>:5500/em`

Specify the User Name as **sys** and the Password . Choose **SYSDBA** from the Connect As drop down list, then click **Login**.



The screenshot shows the Oracle Enterprise Manager login interface. At the top, the Oracle logo is on the left, and the text "Enterprise Manager" is in the center. A "Help" link is on the right. Below the header is a blue bar with the word "Login". The main heading is "Login to Database:orcl". There are three input fields: "User Name" with the value "sys", "Password" with masked characters "*****", and "Connect As" with a dropdown menu showing "SYSDBA". A "Login" button is to the right of the fields. A mouse cursor is pointing at the "Login" button. At the bottom, there is a copyright notice: "Copyright © 1996, 2003, Oracle. All rights reserved."

2. Select the **Administration** link.

The screenshot displays the Oracle Enterprise Manager 10g Database Control interface. The browser window title is "Oracle Enterprise Manager (SYS) - Database: orcl.us.oracle.com - Microsoft Internet Explorer". The address bar shows the URL: http://144.25.8.226:5500/em/console/database/instance/sitemap?event=doLoad&target=orcl.us.oracle.com&type=oracle_database. The page is titled "Database: orcl.us.oracle.com" and shows the user is logged in as SYS. The navigation tabs include Home, Performance, Administration, and Maintenance. The "Performance" tab is selected, and the "View Data" dropdown is set to "Manually".

General

- Status: Up
- Up Since: Jan 8, 2004 9:44:48 AM
- Time Zone: Unavailable
- Availability (%): 100 (Last 24 hours)
- Instance Name: orcl
- Version: 10.1.0.2.0
- Read Only: No
- Oracle Home: /u01/app/oracle/product/10.1.0
- Listener: LISTENER_EDCDR26P1
- Host: edcdr26p1.us.oracle.com

Host CPU

Run Queue: 1.1
Paging (pages per second): 0.0

Active Sessions

No data is currently available.
Active Sessions: Unavailable
SQL Response Time (%): 121.38 (compared to baseline)

High Availability

- Instance Recovery Time (seconds): 11
- Last Backup: n/a
- Archiving: Disabled
- Archive Area Used (%): n/a
- Flashback Logging: Disabled

Space Usage

- Database Size (GB): 1
- Problem Tablespaces: 0
- Segment Findings: Not Configured
- Policy Violations: 0
- Dump Area Used (%): Unavailable

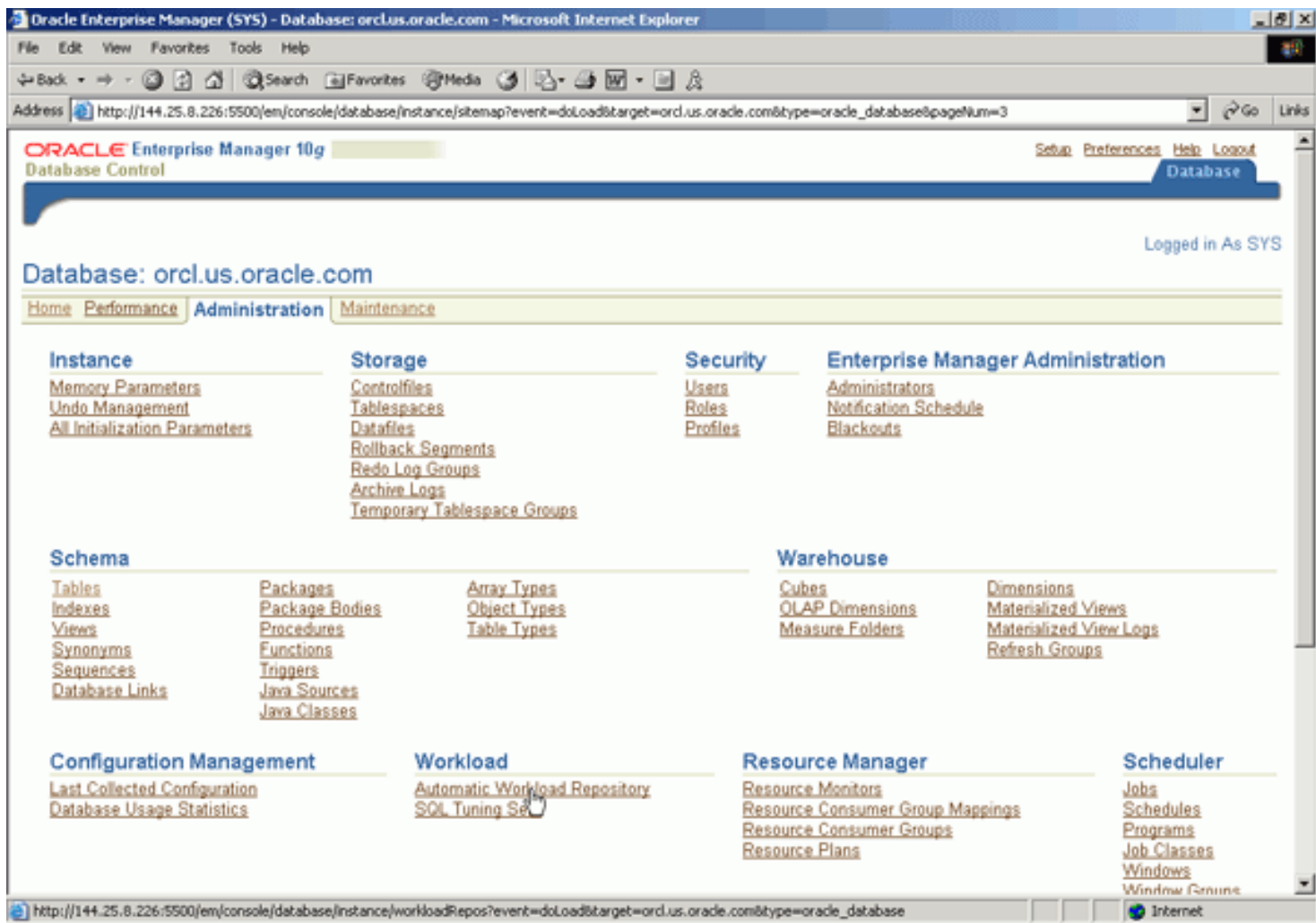
Diagnostic Summary

- Performance Findings: 0
- All Policy Violations: 64
- Alert Log: No ORA- errors

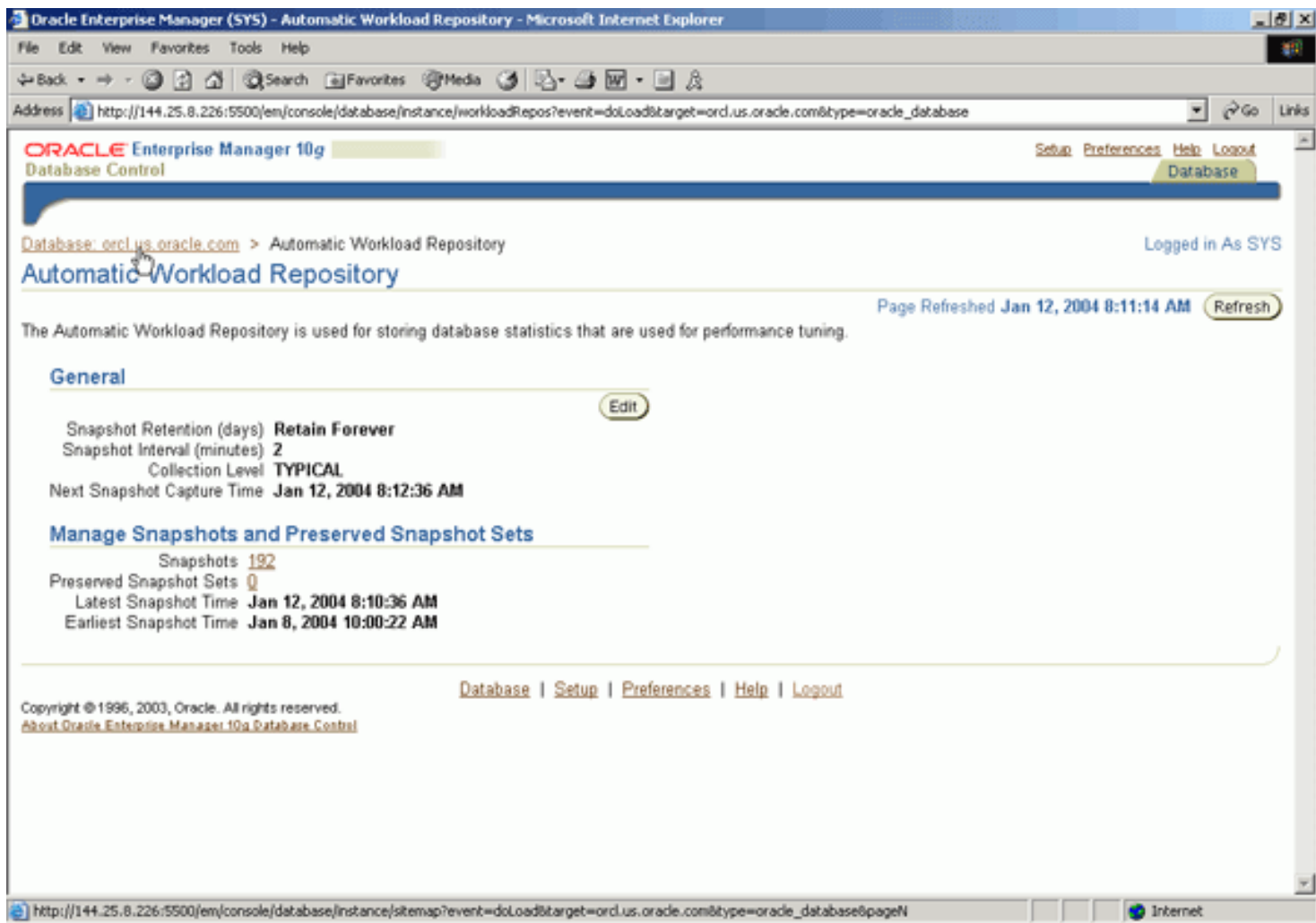
Alerts

Critical: 0

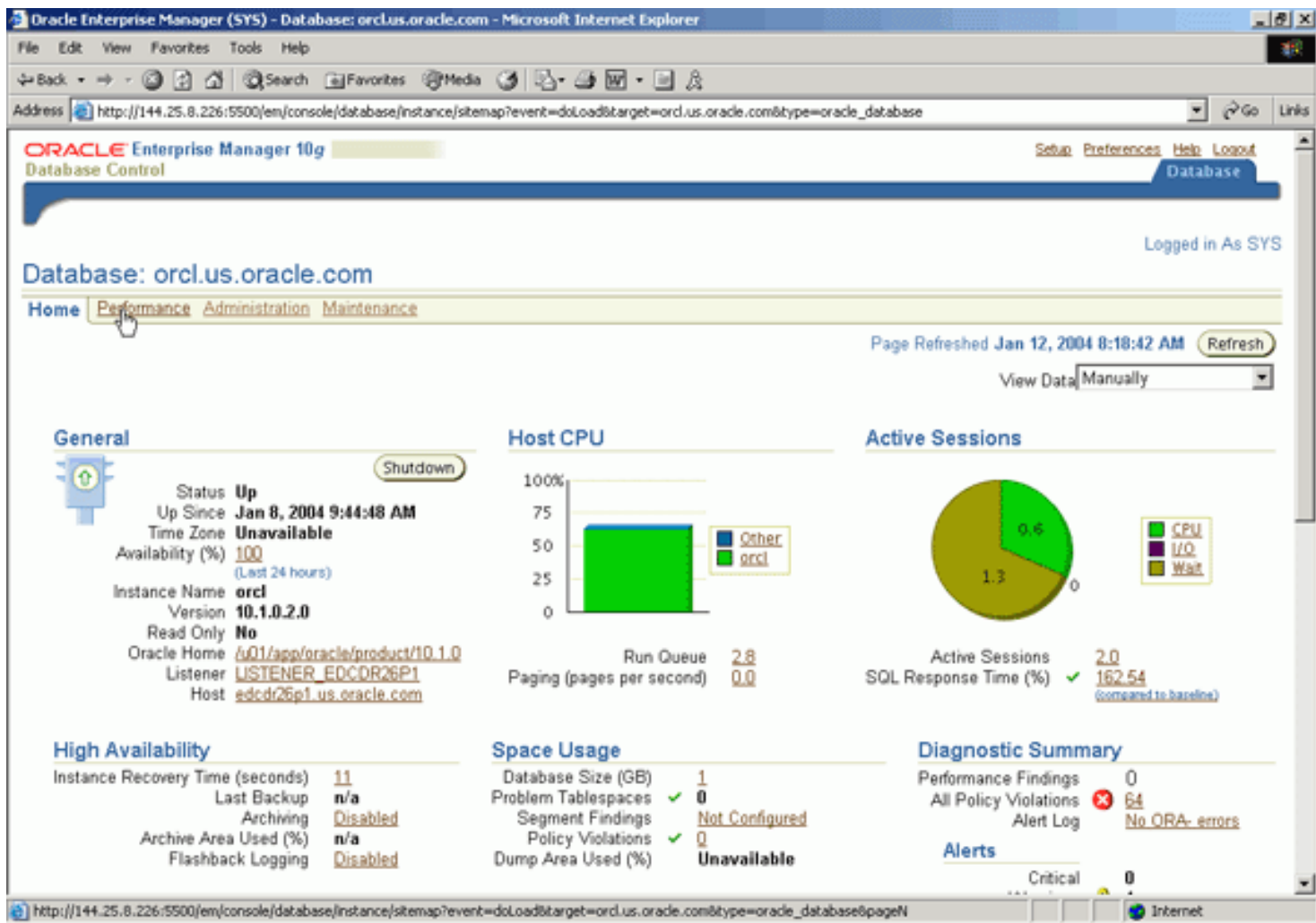
- In the section titled **Workload**, click on the **Automatic Workload Repository** link.



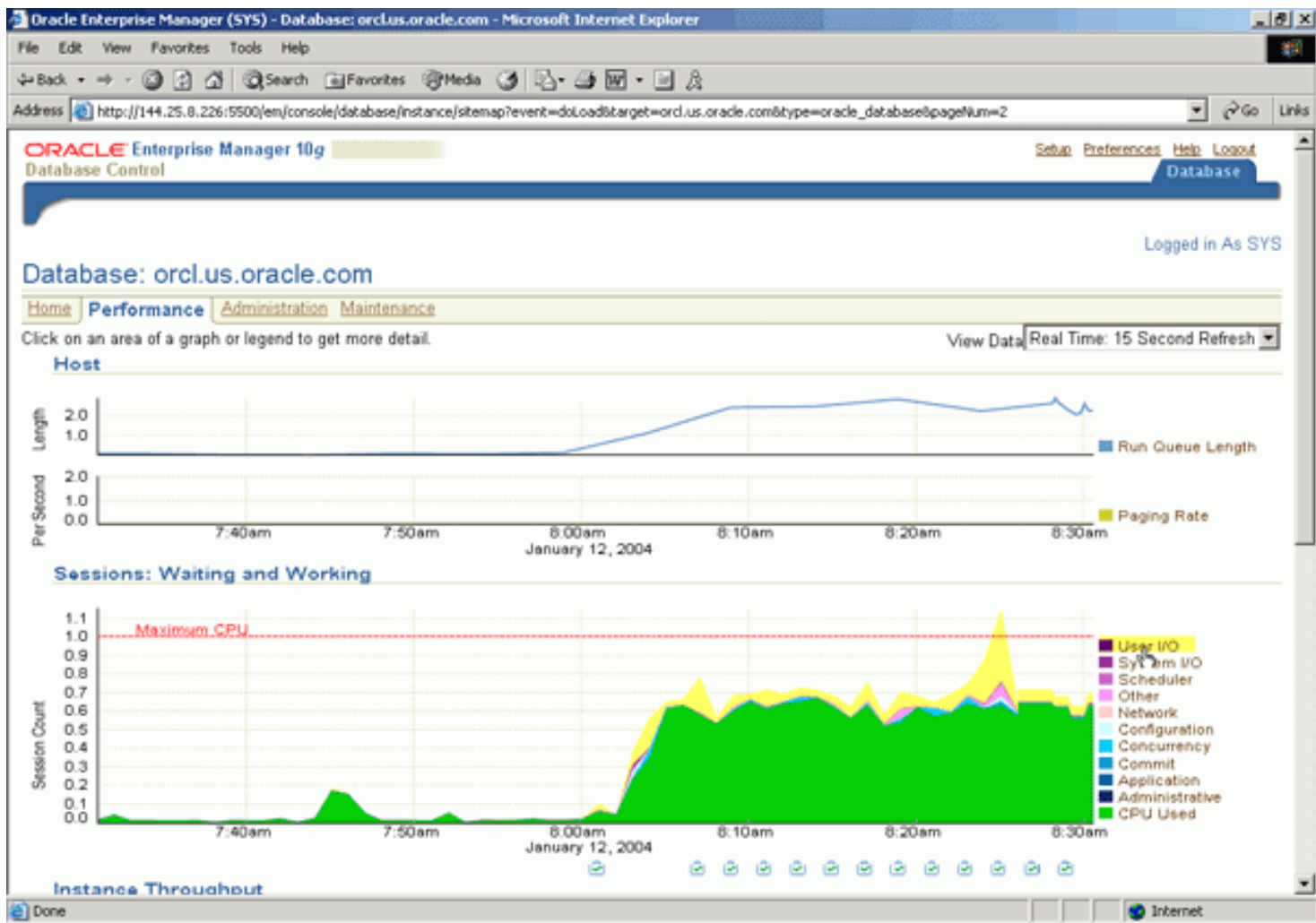
4. Determine how many snapshots have already been collected for this database. Look under **Snapshots** for the count and the time the last ADDM snapshot was taken. There should be at least three snapshots. Click on the **Database** breadcrumb.



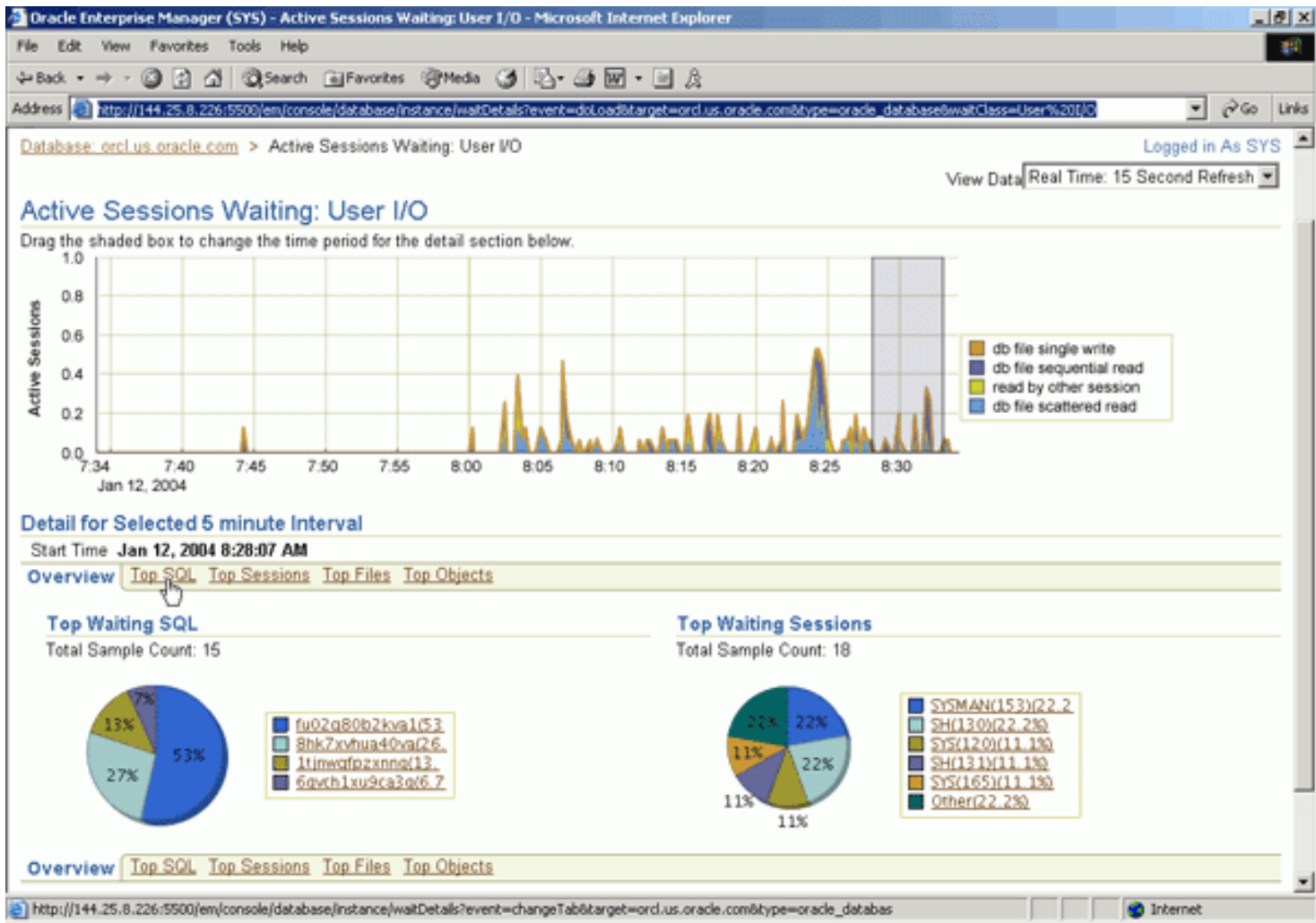
5. Click on the **Performance** link.



6. In the Performance Window, review to the **Sessions: Waiting and Working** graph. A chart representing the current workload of your database is shown. (It may take a minute for the chart to be populated with data) This chart is populated with data collected by the ADDM snapshots. To the side of the graph is the legend. Each legend entry is coded to a different color. You can determine quickly from the graph that the item with the largest time is yellow, or User I/O. Click on the **User I/O** link.



7. Below the Active Sessions Waiting: User I/O chart, there are two pie charts. Investigate the pie chart on the left, **Top Waiting SQL**. This shows that the overwhelming majority of waits 53% were caused by one SQL statement. Investigate the pie chart on the right, **Top Waiting Sessions**. This pie chart shows that the current top active sessions are waiting about the same percentage of time.

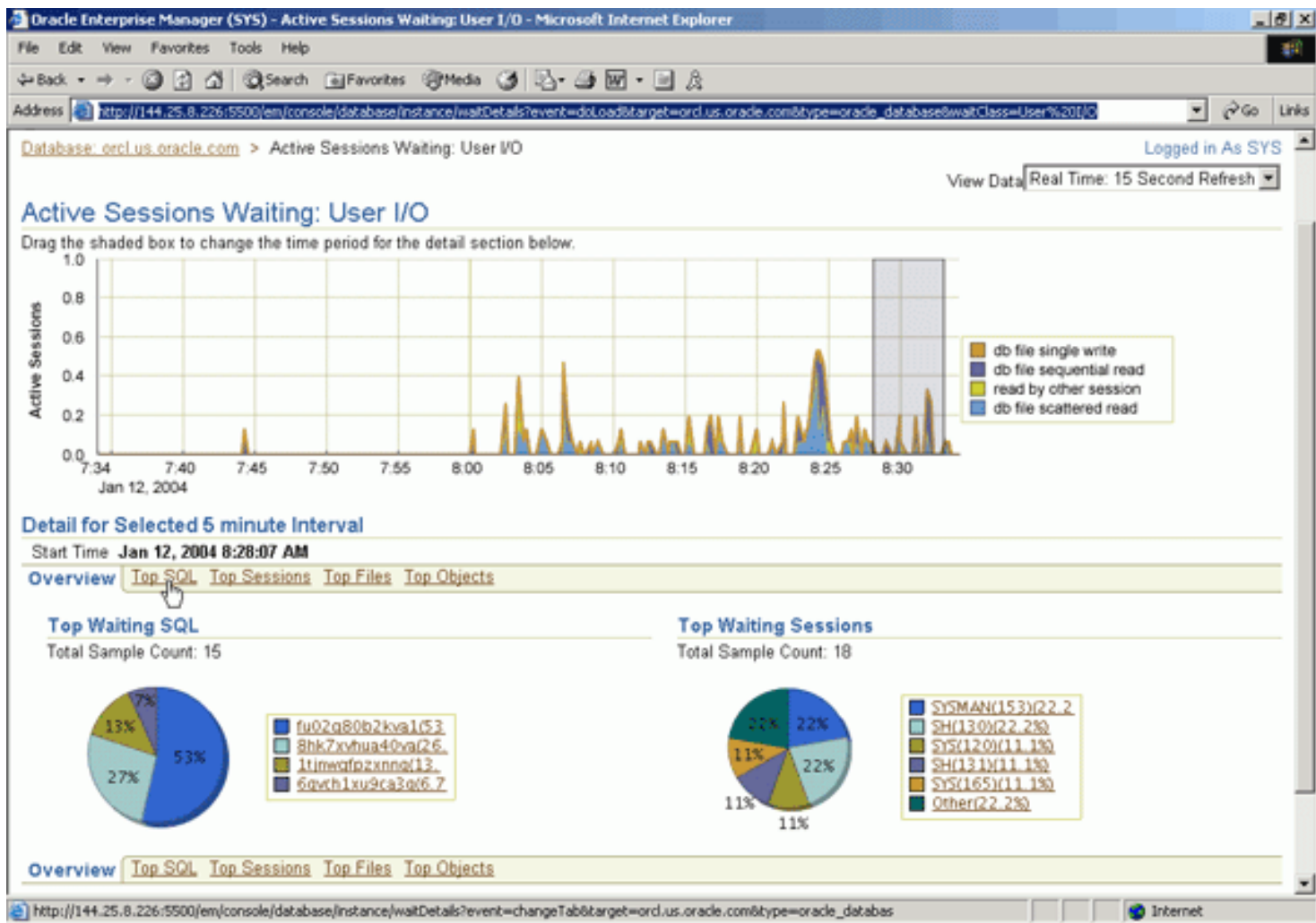


Examining Top SQL for a Database Wait Class

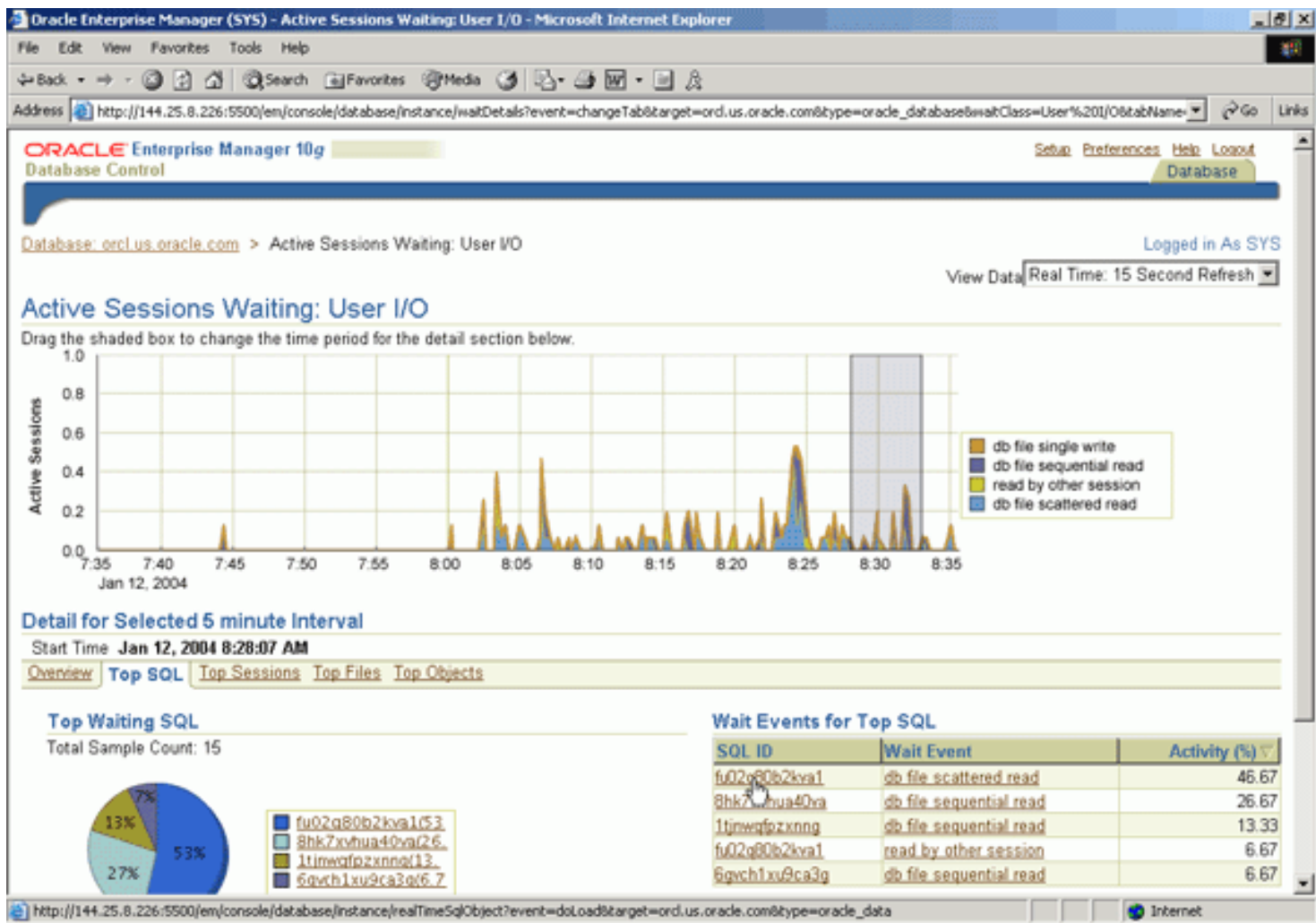
[Back to List](#)

As was shown in the previous task, there is one SQL statement causing the majority of the database wait. In this task you will drill down to find the root cause. Perform the following:

1. From within the Active Sessions Waiting: User I/O page, click on the **Top SQL** tab in the middle of the page.



2. On the detail page that appears, view the **Wait Events for Top SQL** table, which is ordered by Activity (%). You can see the Top SQL statement spent most of its time on the activity 'db file scattered read'. Click on the SQL ID of the SQL statement with the highest percentage of activity.



- The execution plan for this SQL statement is displayed. Click the **Current Statistics** tab.

Oracle Enterprise Manager (SYS) - SQL Details: fu02q80b2kva1 - Microsoft Internet Explorer

Database Control

Database: orcl.us.oracle.com > Top SQL > SQL Details: fu02q80b2kva1

SQL Text: `SELECT time_id, quantity_sold, amount_sold
FROM sales s, customers c
WHERE c.cust_id = s.cust_id
AND cust_first_name = 'Dina'
ORDER BY time_id`

Execution Plan | **Current Statistics** | Execution History | Tuning History

Collected From Target Jan 12, 2004 8:36:06 AM

Data Source: Cursor Cache Plan Hash Value: 3591656836 Module: DEMO
Capture Time: Jan 12, 2004 8:36:06 AM Optimizer Mode: ALL_ROWS Action: FETCH
Parsing Schema: SH

Expand All | Collapse All

Operation	Object	Object Type	Order	Rows	KB Cost	Time (seconds)	CPU Cost	IO Cost	Object Node
SELECT STATEMENT			6		837				
SORT ORDER BY			5	5557	179.083	837	11	255894880	765
HASH JOIN			4	5557	179.083	785	10	248479744	715
TABLE ACCESS FULL	SH.CUSTOMERS	TABLE	1	43	0.504	333	4	22792460	327
PARTITION RANGE ALL			3	918843	18,843.461	425	6	132040296	388
TABLE ACCESS FULL	SH.SALES	TABLE	2	918843	18,843.461	425	6	132040296	388

4. The statistics for this SQL statement is displayed. Click the **Execution History** tab.

Cannot find server - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://144.25.8.226:5500/em/console/database/instance/realTimeSqlObject?event=doLoad&type=oracle_database&target=orcl.us.oracle.com&sql_id=fu02q80b2kva1&planHa Go Links

ORACLE Enterprise Manager 10g Database Control

Database: orcl.us.oracle.com > Top SQL > SQL Details: fu02q80b2kva1

SQL Details: fu02q80b2kva1

Run SQL Tuning Advisor

SQL Text

```
SELECT time_id, quantity_sold, amount_sold
FROM sales s, customers c
WHERE c.cust_id = s.cust_id
AND cust_first_name = 'Dina'
ORDER BY time_id
```

Execution Plan Current Statistics **Executing History** Tuning History

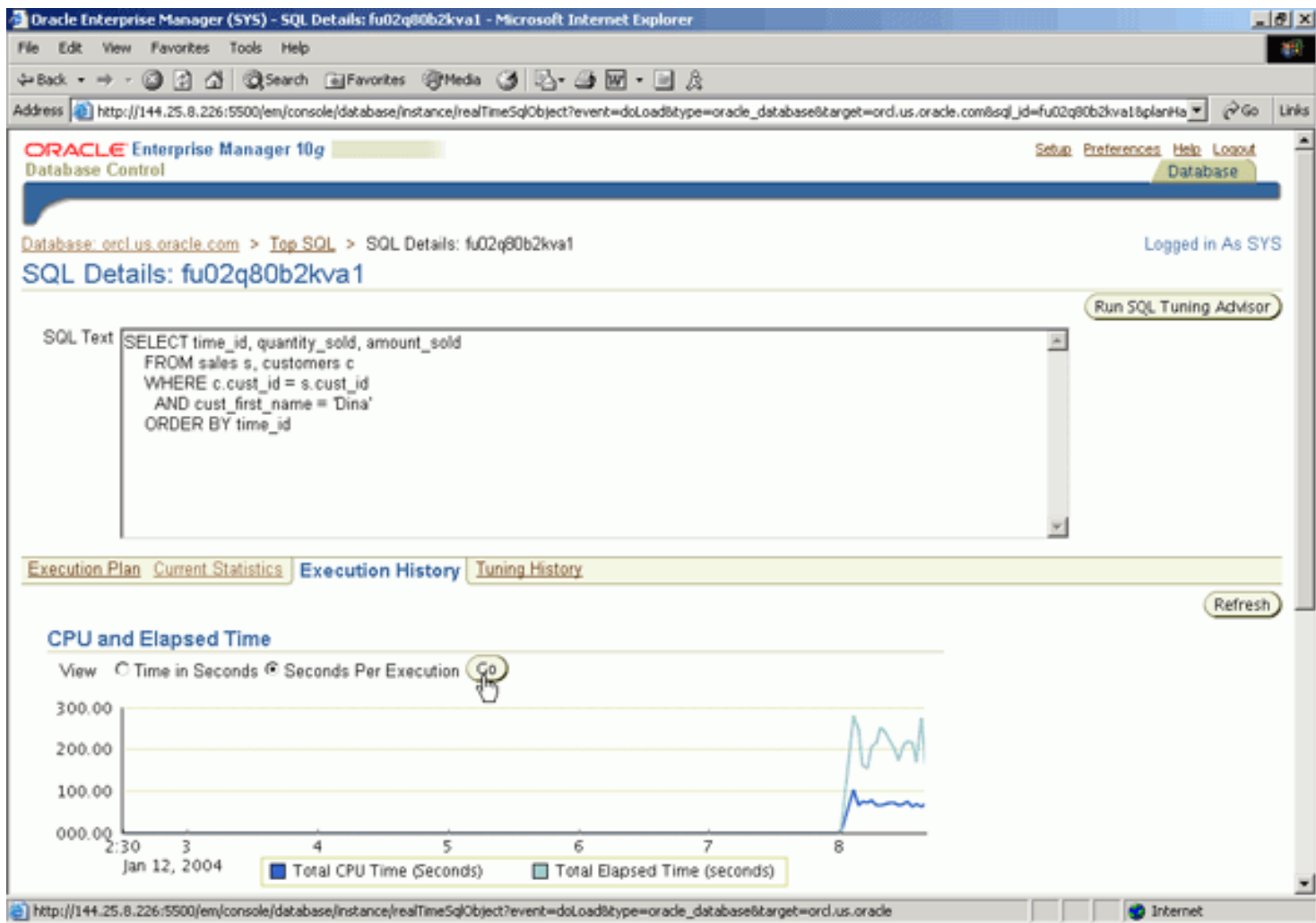
Collected From Target Jan 12, 2004 8:40:08 AM

General		Execution Statistics	
Number of Execution Plans	1	Executions	1233
Program Name (Line Number)	Not Applicable	Parse Calls	1233
SQL Profile	Unavailable	Rows Per Fetch	1.0
SQL Profile Status	Unavailable	Rows Per Execution	3.0
SQL Profile Category	Unavailable	Executions Per Parse Call	1.0

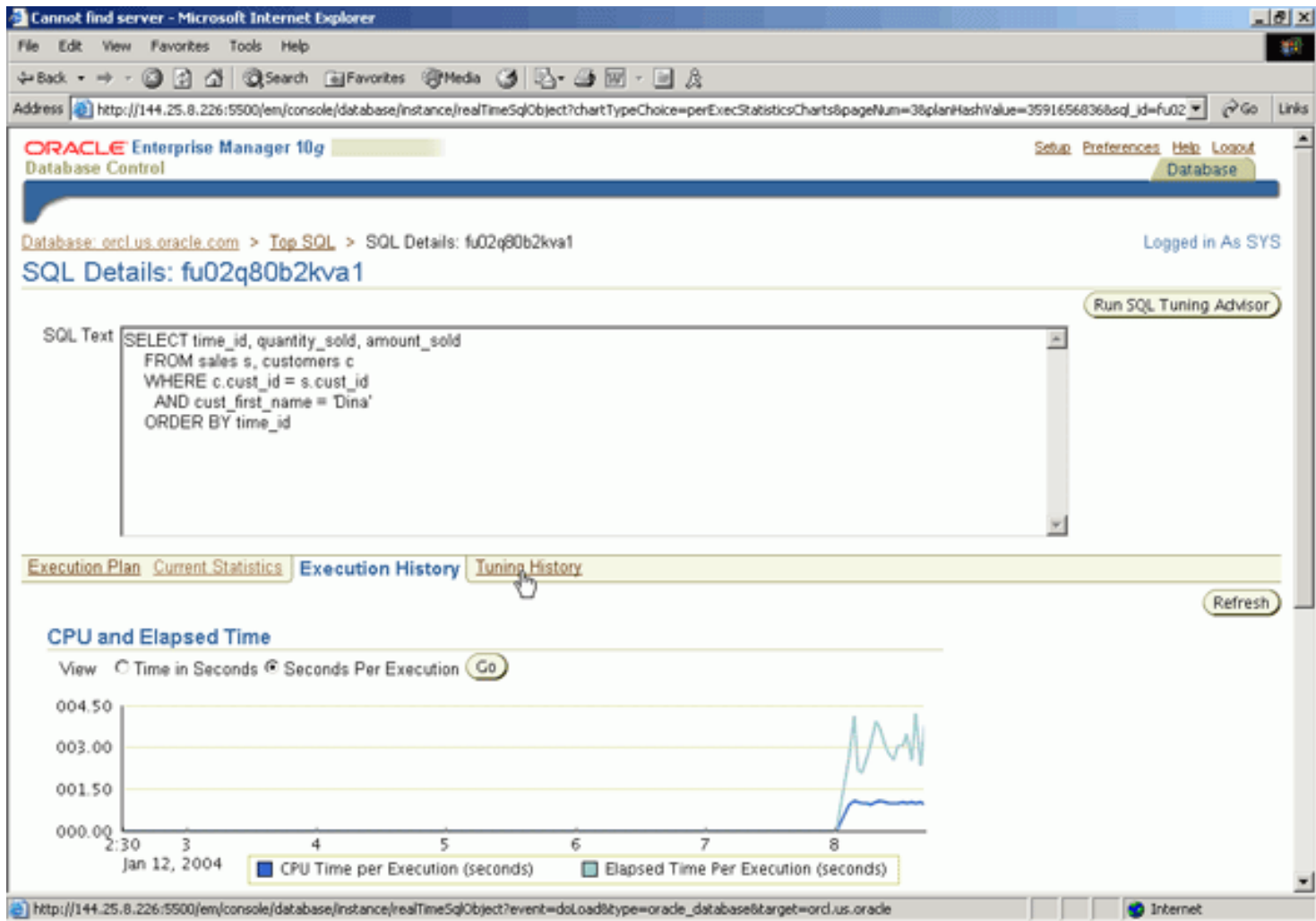
Time Model Statistics		Shared Pool Statistics	
Elapsed Time Per Execution (seconds)	3.02	Shareable Memory (bytes)	16493
CPU Time per Execution (seconds)	1.02	Loads	1
Wait Ratio	.66	Last Load Time	
		Invalidations	0

http://144.25.8.226:5500/em/console/database/instance/realTimeSqlObject?event=doLoad&type=oracle_database&target=orcl.us.oracle.com Internet

- The statistical analysis chart for this SQL statement is displayed. The CPU and Elapsed Time chart shows the amount of CPU used by all executions of this SQL statement over a period of time. Select **Seconds Per Execution** and click on **Go** to display the time and resources used for each execution of this SQL statement.



6. From the displayed charts, it can be determined that CPU resource usage is increasing, and the time it takes to execute this SQL statement is also increasing. Click the **Tuning History** tab.



7. The previous tuning recommendations for this SQL statement is displayed. At this time, there are none. You are now ready to tuning the SQL statement using the SQL Tuning Advisor.

Oracle Enterprise Manager (SYS) - SQL Details: fu02q80b2kva1 - Microsoft Internet Explorer

Database: orcl.us.oracle.com > Top SQL > SQL Details: fu02q80b2kva1

SQL Text: `SELECT time_id, quantity_sold, amount_sold
FROM sales s, customers c
WHERE c.cust_id = s.cust_id
AND cust_first_name = 'Dina'
ORDER BY time_id`

Run SQL Tuning Advisor

Execution Plan | Current Statistics | Execution History | Tuning History

Collected From Target Jan 12, 2004 8:50:56 AM

The following table lists all the recommendations available for the SQL statement.

Plan Hash Value	Advisor Task Owner	Advisor Task Name	Task Completion
(No data)			

Execution Plan | Current Statistics | Execution History | Tuning History

Run SQL Tuning Advisor

Database | Setup | Preferences | Help | Logout

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About Oracle Enterprise Manager 10g Database Control

Tune a SQL Statement Using the SQL Tuning Advisor

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As determined in the previous section on reactive tuning, the targeted SQL statement needs tuning. The SQL Tuning Advisor will tune the execution plan for you. Perform the following:

1. Click **Run SQL Tuning Advisor** .

Oracle Enterprise Manager 10g Database Control

Database: orcl.us.oracle.com > Top SQL > SQL Details: fu02q80b2kva1

SQL Text: `SELECT time_id, quantity_sold, amount_sold
FROM sales s, customers c
WHERE c.cust_id = s.cust_id
AND cust_first_name = 'Dina'
ORDER BY time_id`

Run SQL Tuning Advisor

Execution Plan | Current Statistics | Execution History | **Tuning History**

Collected From Target Jan 12, 2004 8:50:56 AM

The following table lists all the recommendations available for the SQL statement.

Plan Hash Value	Advisor Task Owner	Advisor Task Name	Task Completion
(No data)			

Execution Plan | Current Statistics | Execution History | **Tuning History**

Run SQL Tuning Advisor

Database | Setup | Preferences | Help | Logout

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2. At the Schedule Advisor window, make sure the Scope **Comprehensive** is selected and the job will be scheduled **Immediately** . Click **OK** .

Oracle Enterprise Manager (SYS) - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://144.25.8.226:5500/em/console/database/instance/sqltune?event=tunesql&target=orcl.us.oracle.com&type=oracle_database&sql_id=fu02q80b2kva1&planHashValue=3 Go Links

ORACLE Enterprise Manager 10g Database Control

Setup Preferences Help Logout Database

Database: orcl.us.oracle.com > Schedule Advisor

Logged in As SYS

Schedule Advisor

Enter the start date and time for the run of the advisor. A database job will be submitted at the time. You can also limit the amount of time for the run of the advisor. After reaching this limit, the advisor run will be interrupted and return partial results. You can check the status of any advisor run through Advisor Central.

Cancel OK

Name:

Description:

SQL Statements

SQL Text	Parsing Schema
select time_id, QUANTITY_SOLD, AMOUNT_SOLD from sales s, customers c where c.cust_id = s.cust_id and CUST_FIRST_NAME='Dina' order by time_id	SH

Scope

☐ Limited. Analysis without SQL Profile recommendation. Takes about 1 second per statement.
☒ Comprehensive. Complete analysis including SQL Profile. May take a long time.

Total Time Limit (minutes):

Schedule

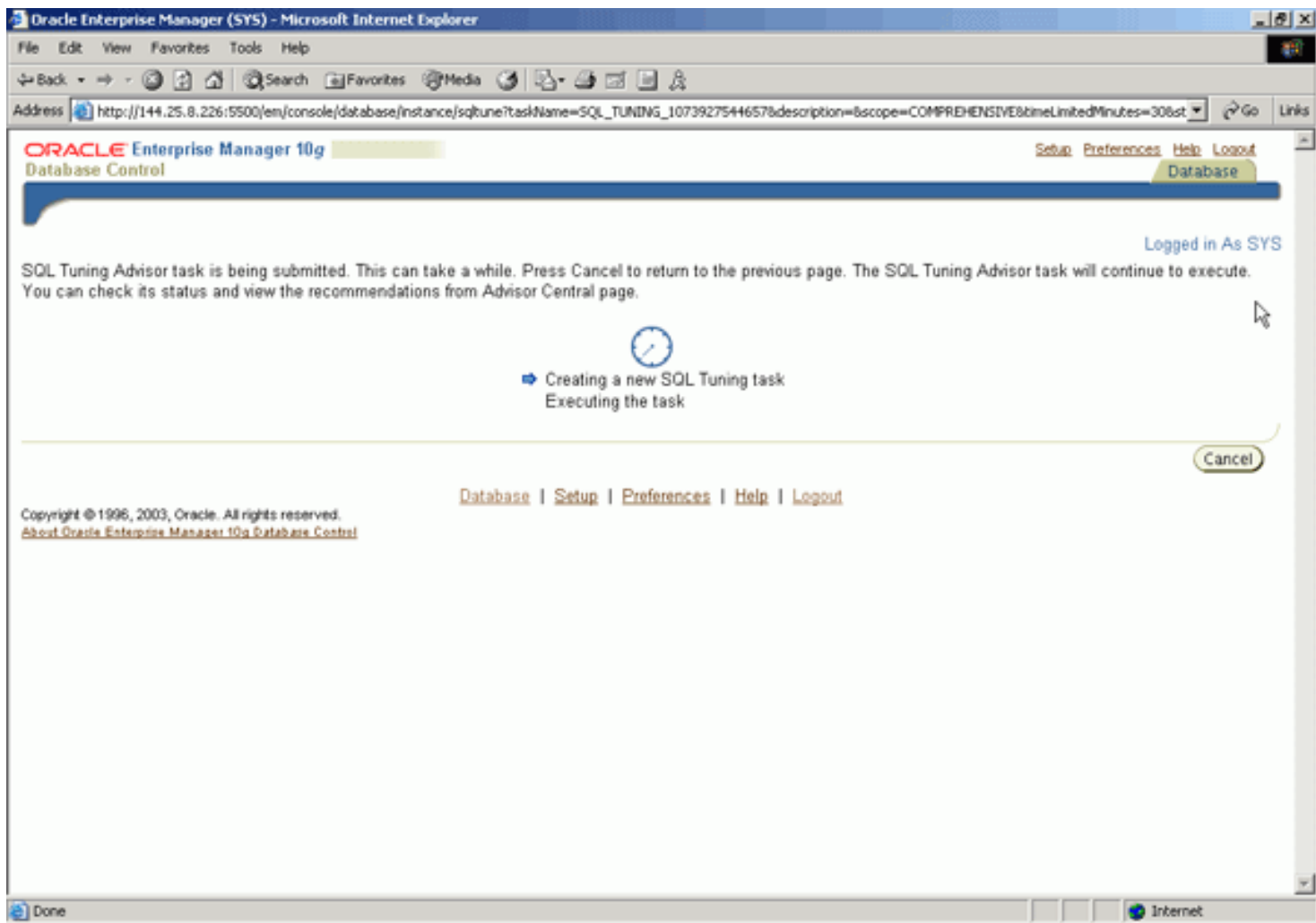
Time Zone:

☒ Immediately
☐ Later

Date:

http://144.25.8.226:5500/em/console/database/instance/sqltune?event=tunesql&target=orcl.us.oracle.com&type=oracle_database&sql_ Internet

- The SQL Tuning Advisor will create a task to analyze the SQL statement, and upon completion of this task, displays a set of tuning recommendations.



4. Click **View Recommendations** .

Oracle Enterprise Manager (SYS) - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://144.25.8.226:5500/em/console/database/instance/sqltune?task_id=234&event=view_result&advisoryCentralURL=/em/console/database/instance/advisorTasks%3FdbP... Go Links

ORACLE Enterprise Manager 10g Database Control

Setup Preferences Help Logout Database

Database: orcl.us.oracle.com > Advisor Central > SQL Tuning Results:SQL_TUNING_1073927544657 Logged in As SYS

SQL Tuning Results:SQL_TUNING_1073927544657

Status **COMPLETED**
 Started **Jan 12, 2004 9:14:59 AM**
 Completed **Jan 12, 2004 9:15:39 AM**

SQL ID **fu02q80b2kva1**
 Time Limit (seconds) **1800**
 Running Time (seconds) **40**

Page Refreshed Jan 12, 2004 9:17:33 AM Refresh

Recommendations

View Recommendations

Select	SQL Text	Parsing Schema	SQL ID	Statistics	SQL Profile	Index	Restructure SQL	Miscellaneous Error
<input checked="" type="radio"/>	select time_id, QUANTITY_SOLD, AMOUNT_SOLD from sales s, customers c ...		fu02q80b2kva1		✓			

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Database | Setup | Preferences | Help | Logout

http://144.25.8.226:5500/em/console/database/instance/sqltune?task_id=234&event=view_result&advisoryCentralURL=/em/console/data Internet

- Click on the **New Explain Plan** button to view the suggested change.

Oracle Enterprise Manager (SYS) - Microsoft Internet Explorer

Database Control

Database: orcl.us.oracle.com > Advisor Central > SQL Tuning Results: SQL_TUNING_1073927544657 > Recommendations for SQL ID: fu02q80b2kva1

Logged in As SYS

Recommendations for SQL ID: fu02q80b2kva1

Only one recommendation should be implemented.

SQL Text

```
select time_id, QUANTITY_SOLD, AMOUNT_SOLD from sales s, customers c where c.cust_id = s.cust_id and CUST_FIRST_NAME='Dina' order by time_id
```

Select Recommendation

Original Explain Plan

Implement

Select Type	Findings	Rationale	Benefit (%)	New Explain Plan
SQL Profile	A potentially better execution plan was found for this statement.		99.97	

Return

Database | Setup | Preferences | Help | Logout

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About Oracle Enterprise Manager 10g Database Control

http://144.25.8.226:5500/em/console/database/instance/sqltune?planType=new&objectId=1&event=newPlan&target=orcl.us.oracle.com&t

6. As can be seen, the new explain plan removes the full table scans. Click on the browser back button to return to the previous page.

Oracle Enterprise Manager (SYS) - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://144.25.8.226:5500/em/console/database/instance/sqltune?planType=new&objectId=18&event=newPlan&target=orcl.us.oracle.com&type=oracle_database&task_id=23 Go Links

ORACLE Enterprise Manager 10g Database Control

Setup Preferences Help Logout

Database

Database: orcl.us.oracle.com > [Advisor Central](#) > [SQL Tuning Results:SQL_TUNING_1073927544657](#) > [Recommendations for SQL ID:6j02q60b2kva1](#) > [New Explain Plan](#)

Logged in As SYS

New Explain Plan

[Expand All](#) | [Collapse All](#)

Operation	Line ID	Order	Rows	KB	Cost	Time (seconds)	CPU Cost	IO Cost	Object	Object Type	Object Node
SELECT STATEMENT	0	6	4	0.129	7	1	76434	7			
NESTED LOOPS	1	5	4	0.129	7	1	76434	7			
TABLE ACCESS BY GLOBAL INDEX ROWID	2	2	918843	18,843.461	4	1	29695	4	SH.SALES	TABLE	
INDEX FULL SCAN	3	1	3		3	1	21964	3	SH.SALES_TIME_IDX	INDEX	
TABLE ACCESS BY INDEX ROWID	4	4	1	0.012	1	1	15512	1	SH.CUSTOMERS	TABLE	
INDEX UNIQUE SCAN	5	3	1			1	8171		SH.CUSTOMERS_PK	INDEX (UNIQUE)	

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Database | Setup | Preferences | Help | Logout

http://144.25.8.226:5500/em/console/database/instance/sqltune?event=viewstmt&task_id=234&objectId=18&target=orcl.us.oracle.com&type=oracle_database&task_id=23 Internet

- Click on the **Implement** button to implement the tuning recommendation.

The screenshot shows the Oracle Enterprise Manager 10g interface in a Microsoft Internet Explorer browser. The page title is "Oracle Enterprise Manager (SYS) - Microsoft Internet Explorer". The address bar shows the URL: http://144.25.8.226:5500/em/console/database/instance/sqltune?event=viewstmt&task_id=234&objectId=1&target=orcl.us.oracle.com&type=oracle_database&objectId=1.

The page content includes the Oracle logo and "Database Control" header. The breadcrumb trail is: [Database: orcl.us.oracle.com](#) > [Advisor Central](#) > [SQL Tuning Results:SQL_TUNING_1073927544657](#) > Recommendations for SQL ID:fu02q80b2kva1. The user is logged in as SYS.

The main heading is "Recommendations for SQL ID:fu02q80b2kva1". Below it, a message states: "Only one recommendation should be implemented." The "SQL Text" is: `select time_id, QUANTITY_SOLD, AMOUNT_SOLD from sales s, customers c where c.cust_id = s.cust_id and CUST_FIRST_NAME='Dina' order by time_id`.

The "Select Recommendation" section shows a table with one recommendation:

Select Type	Findings	Rationale	Benefit (%)	New Explain Plan
<input checked="" type="radio"/> SQL Profile	A potentially better execution plan was found for this statement.		99.97	aa

Buttons for "Original Explain Plan", "Implement", and "Return" are visible. The footer includes copyright information: "Copyright © 1996, 2003, Oracle. All rights reserved. About Oracle Enterprise Manager 10g Database Control".

8. A confirmation page appears indicating that the SQL Profile was successfully created. Click the **Database** breadcrumb.

ORACLE

[Setup](#) [Preferences](#) [Help](#) [Logout](#)

Enterprise Manager

Database

Database: orcl > [Advisor Central](#) > SQL Tuning Results: TASK_00048

Confirmation

The recommended SQL Profile was created successfully.

SQL Tuning Results

Task name	TASK_00048	Task status	COMPLETED
Tuning mode	COMPREHENSIVE	Time limit	1800
SQL ID	8c2xqj2bhkj7j	Running time	6 seconds
Started at	Sep 19, 2003 5:41:09 AM	Completed at	Sep 19, 2003 5:41:15 AM

Overview of recommendations

[View Recommendations](#)[Previous](#) 1-1 of 1 [Next](#)

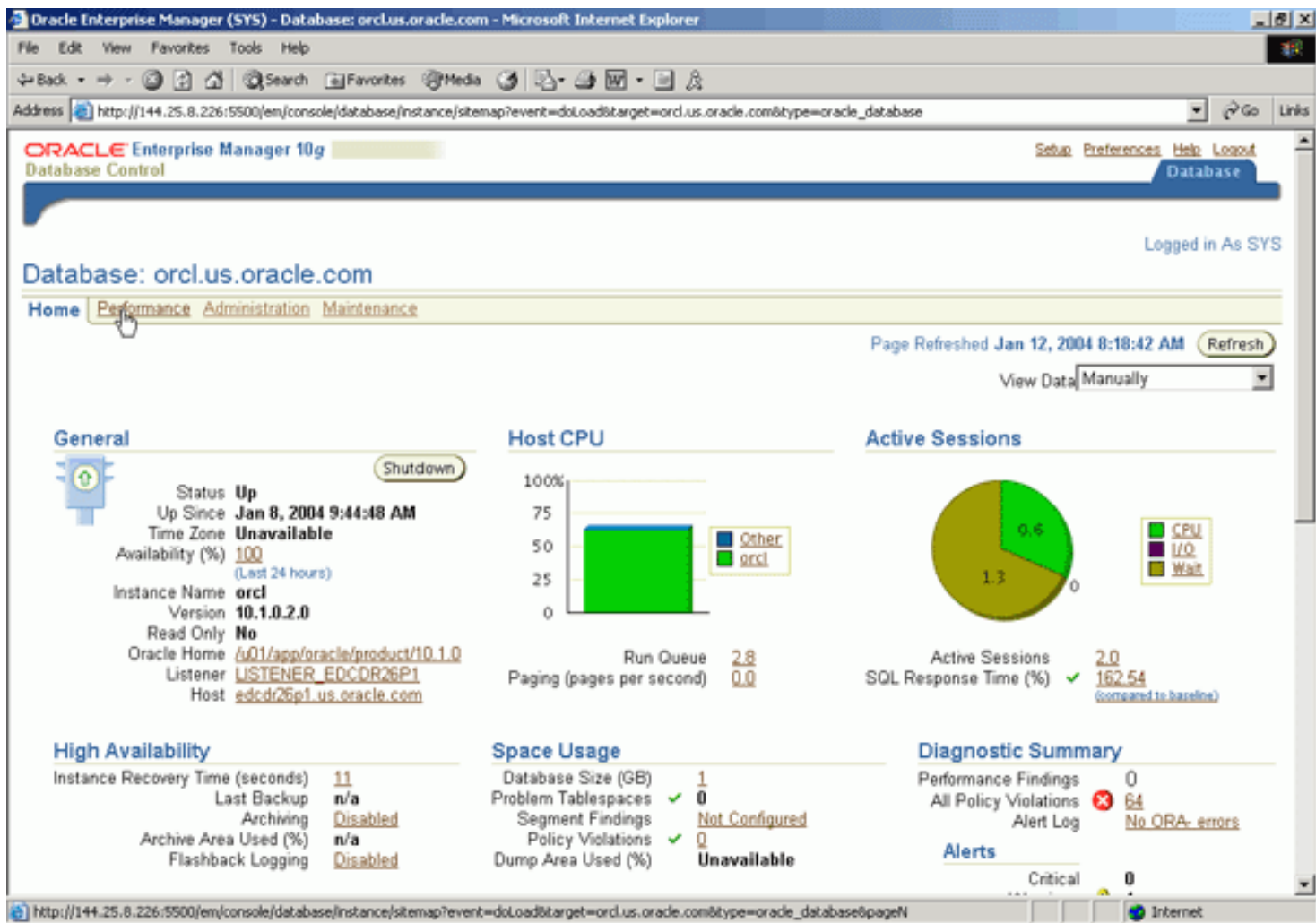
Select	Parsing Schema	SQL Text	Statistics	SQL Profile	Index	Restructure SQL	Misc	Error
		select time_id, QUANTITY_SOLD, AMOUNT_SOLD from sales s, customers c ...		✓				

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[About Oracle Enterprise Manager Database Console](#)[Back to List](#)

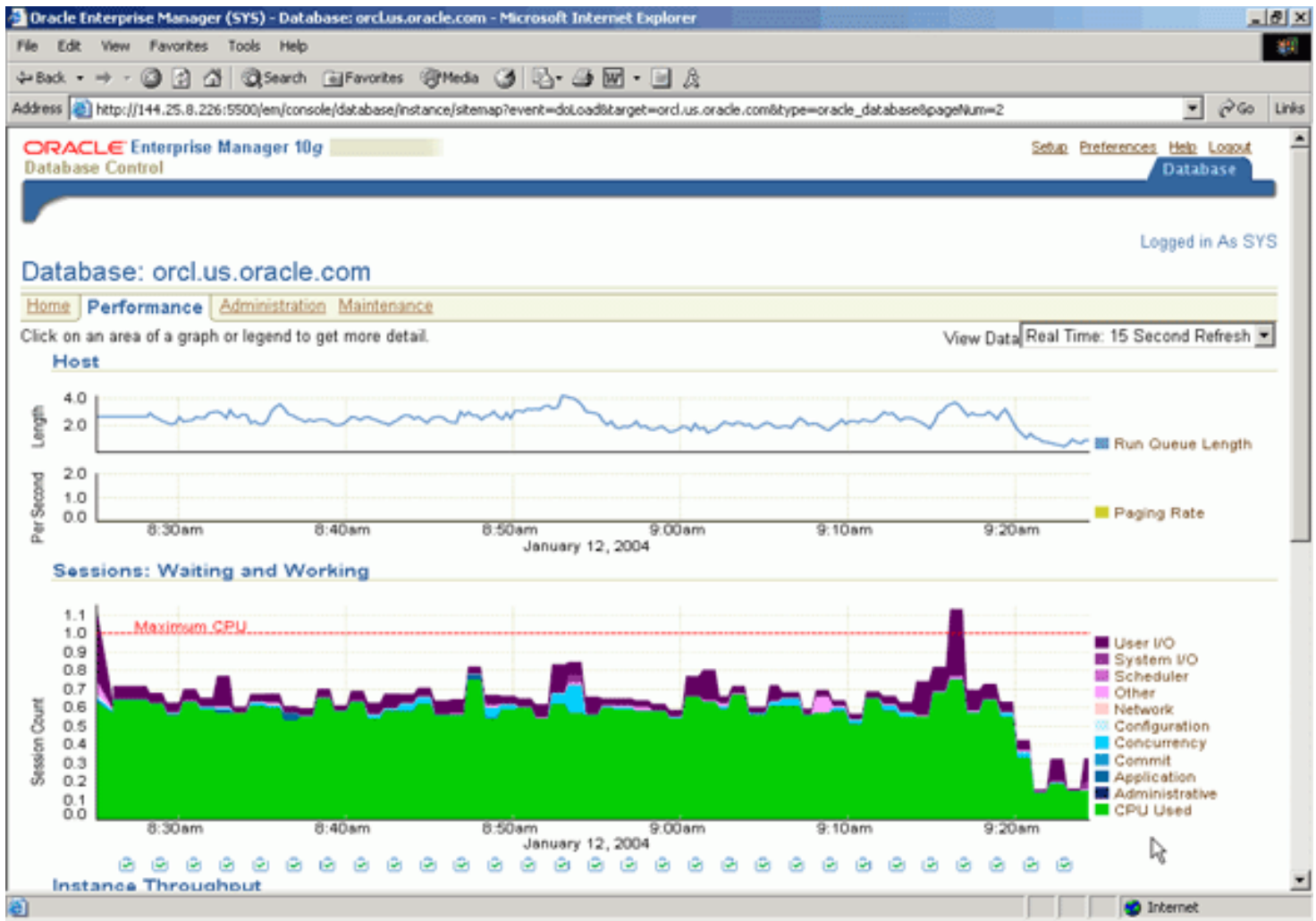
Reviewing SQL Execution Details for a SQL Statement


Now that you have implemented the tuning suggestion, review the SQL statement and its execution details. Perform the following steps.

1. Click on the **Performance** tab.



2. Scroll down to the **Sessions: Waiting and Working** chart. Wait for about one minute and observe how the User I/O is decreasing.



 Place the cursor on this icon to hide all screenshots.