

# 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

[Back to Topic List](#)

### 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

[Back to Topic List](#)

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

[Back to List](#)

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:

```
./
```

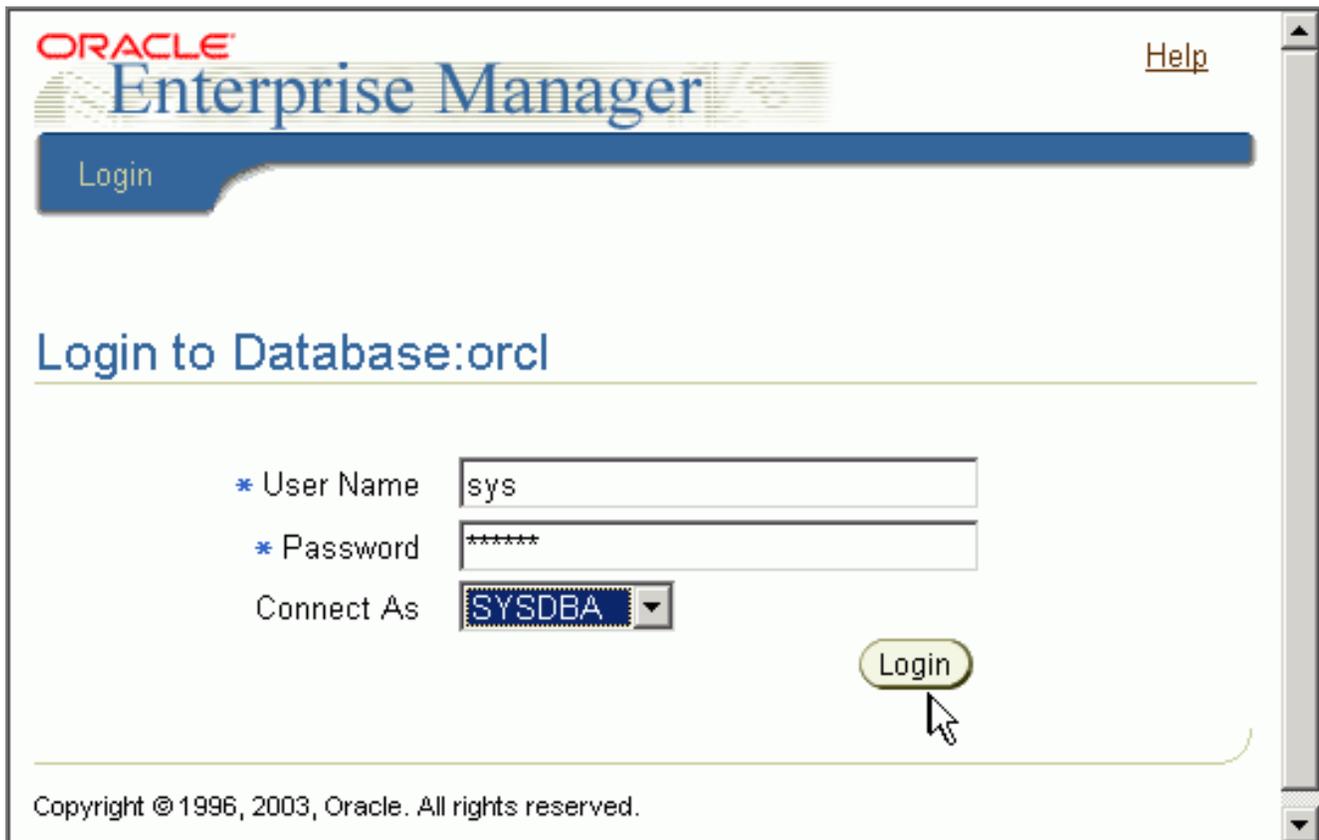
```
setup_perflab.sh
```

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**.



ORACLE  
Enterprise Manager

Help

Login

Login to Database:orcl

\* User Name

\* Password

Connect As

Login

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2. Select the **Administration** link.

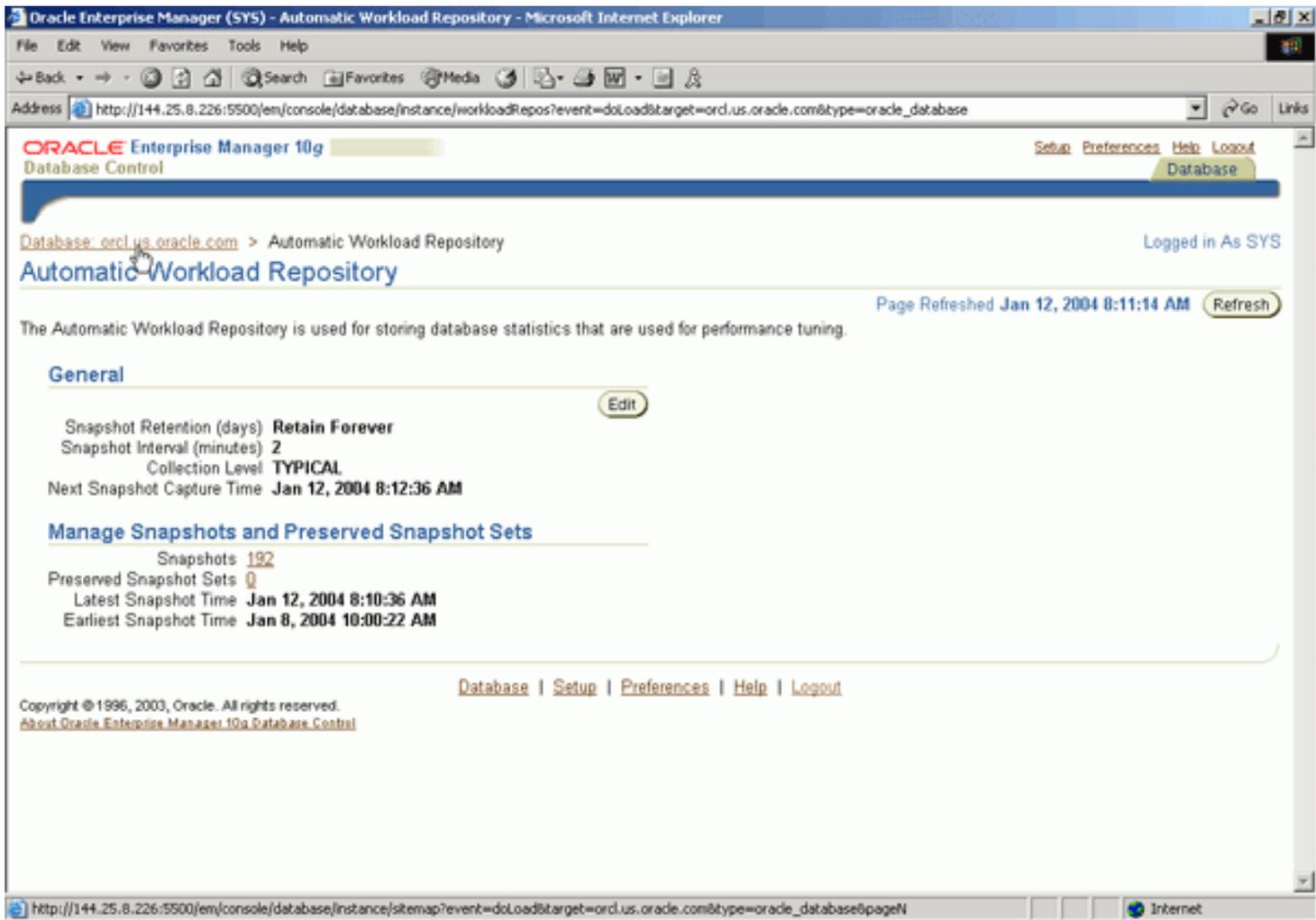
The screenshot displays the Oracle Enterprise Manager 10g Database Control interface. The browser window title is "Oracle Enterprise Manager (SYS) - Database: orcl.us.oracle.com - Microsoft Internet Explorer". The address bar shows the URL: [http://144.25.8.226:5500/em/console/database/instance/sitemap?event=doLoad&target=orcl.us.oracle.com&type=oracle\\_database](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 is logged in as SYS. The navigation menu includes Home, Performance, Administration, and Maintenance. The main content area is divided into several sections:

- General:** Status is Up, Up Since Jan 8, 2004 9:44:48 AM, Time Zone is Unavailable, Availability is 100% (Last 24 hours), Instance Name is orcl, Version is 10.1.0.2.0, Read Only is No, Oracle Home is /u01/app/oracle/product/10.1.0, Listener is LISTENER\_EDCDR26P1, and Host is edcdr26p1.us.oracle.com. A Shutdown button is visible.
- Host CPU:** A bar chart shows CPU usage for 'Other' and 'orcl'. Below the chart, Run Queue is 1.1 and Paging (pages per second) is 0.0.
- Active Sessions:** No data is currently available. Active Sessions is Unavailable and SQL Response Time (%) is 121.38 (compared to baseline).
- High Availability:** Instance Recovery Time (seconds) is 11, Last Backup is n/a, Archiving is Disabled, Archive Area Used (%) is n/a, and Flashback Logging is Disabled.
- Space Usage:** Database Size (GB) is 1, Problem Tablespaces is 0, Segment Findings is Not Configured, Policy Violations is 0, and Dump Area Used (%) is Unavailable.
- Diagnostic Summary:** Performance Findings is 0, All Policy Violations is 64, and Alert Log is No ORA- errors.
- Alerts:** Critical alerts are 0.

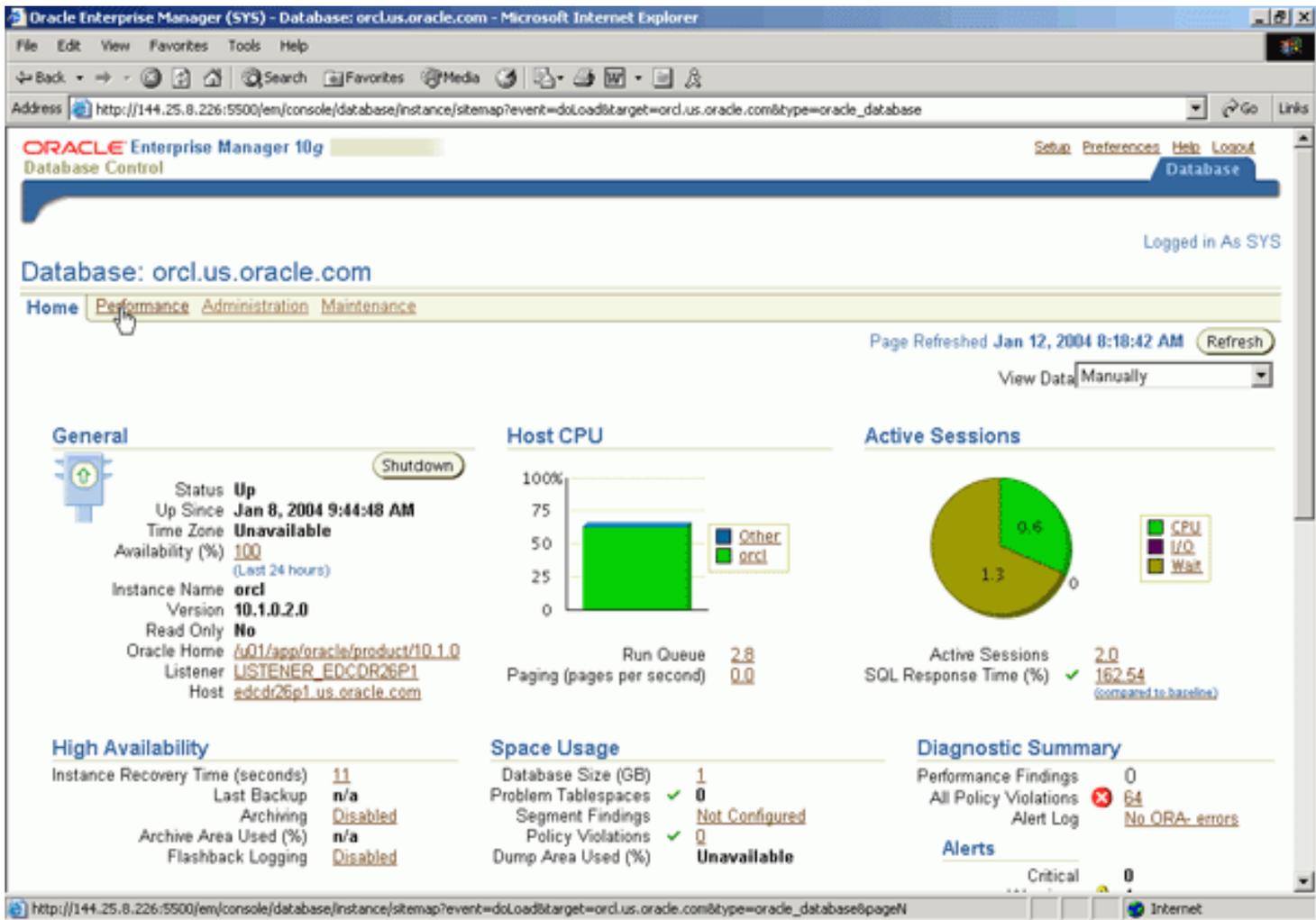
The footer of the browser window shows the URL: [http://144.25.8.226:5500/em/console/database/instance/sitemap?event=doLoad&target=orcl.us.oracle.com&type=oracle\\_database&page#](http://144.25.8.226:5500/em/console/database/instance/sitemap?event=doLoad&target=orcl.us.oracle.com&type=oracle_database&page#).

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

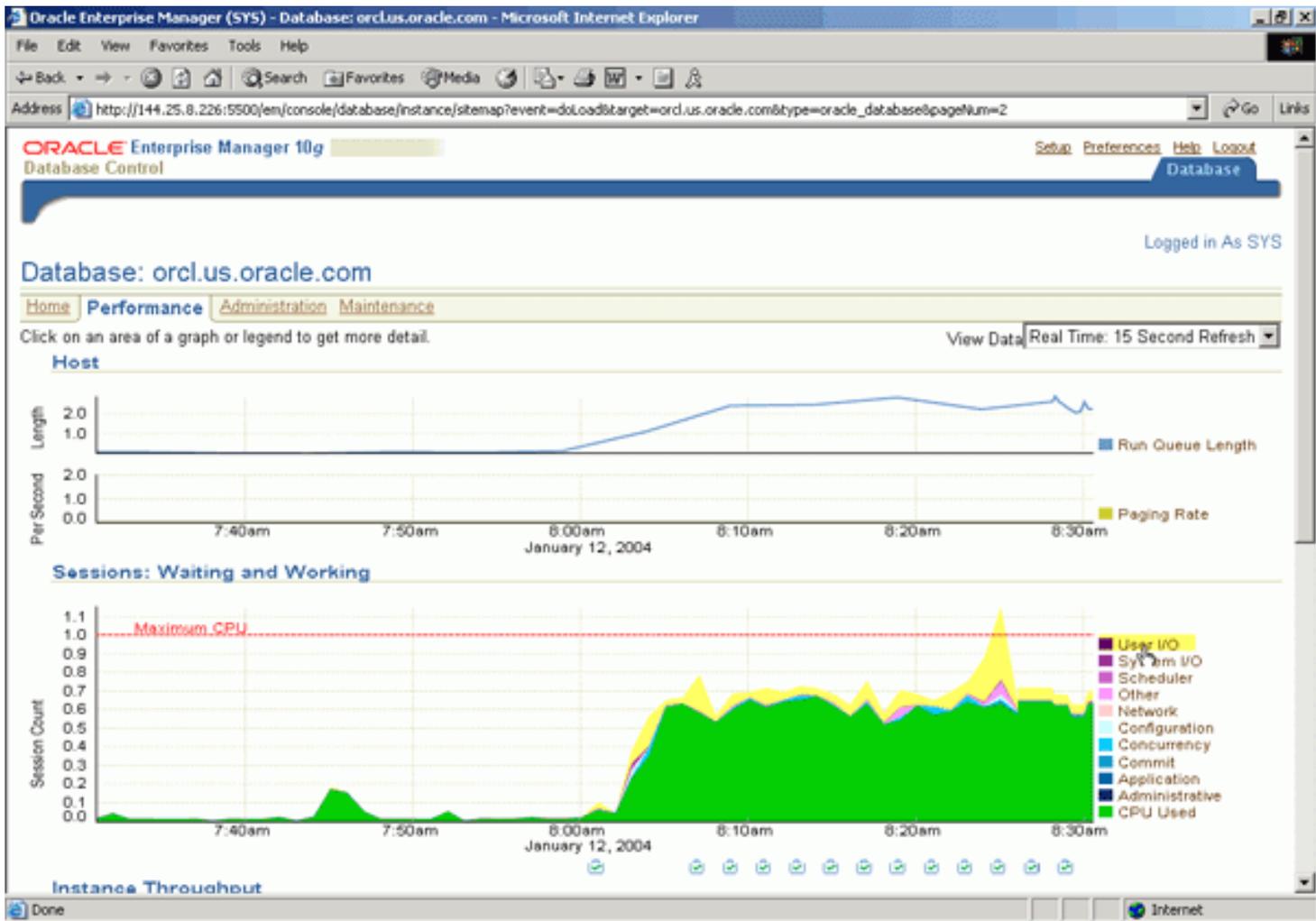
4. Determine how many snapshots have already been collected for this database. Look under **Snapshots** for the count and the time the last ADDM snapshot was taken. There should be at least three snapshots. Click on the **Database** breadcrumb.



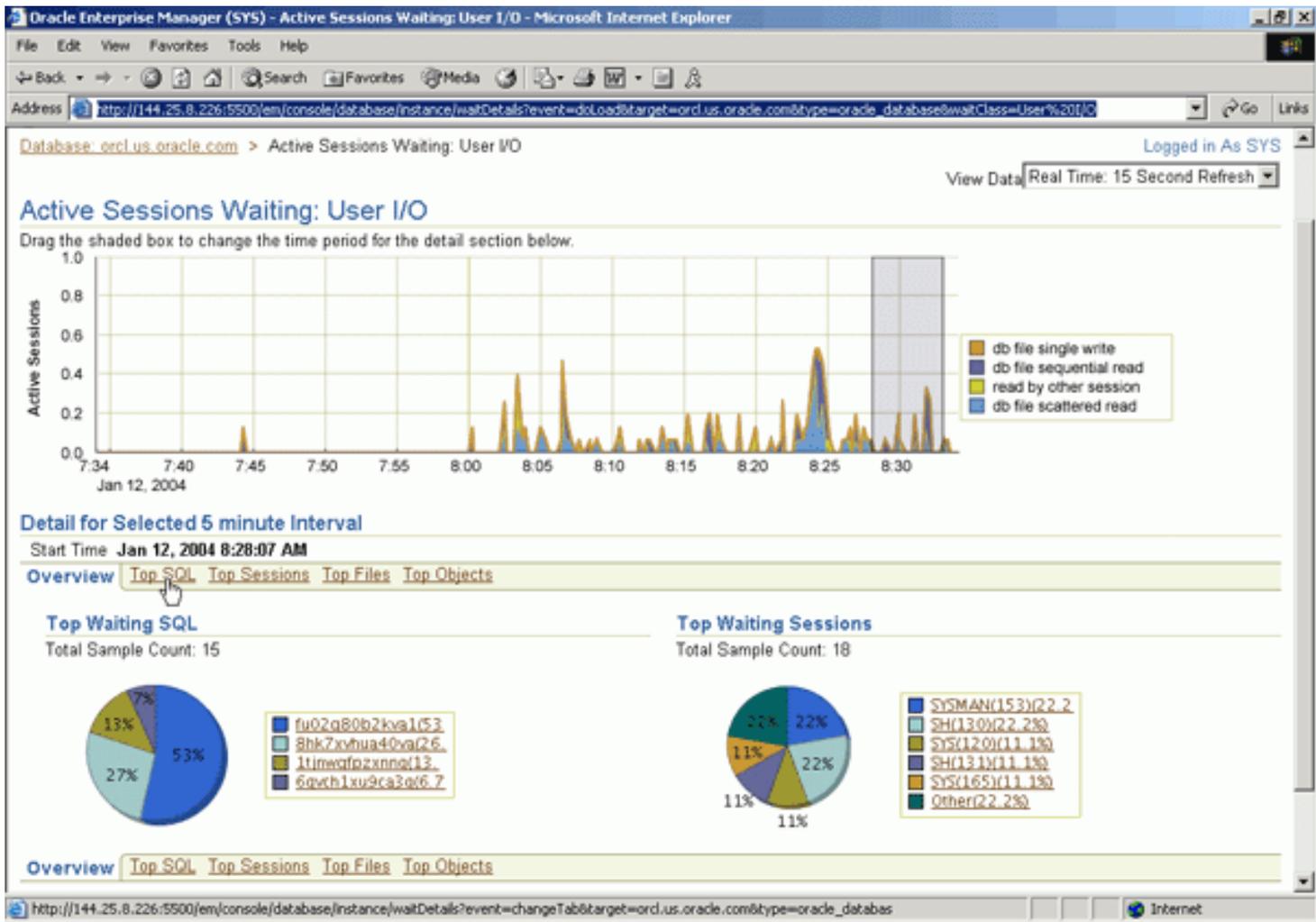
5. Click on the **Performance** link.



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.

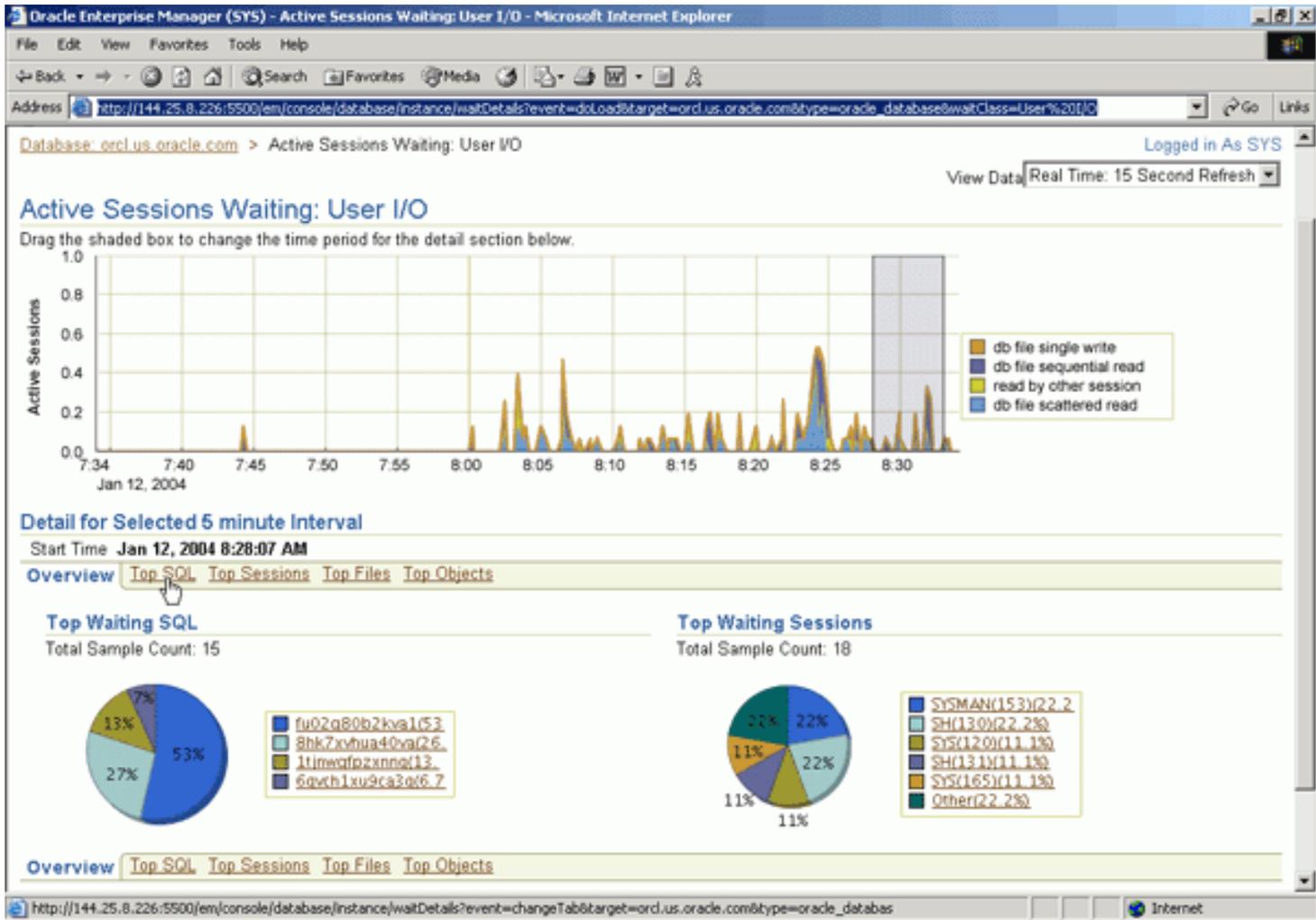


## Examining Top SQL for a Database Wait Class

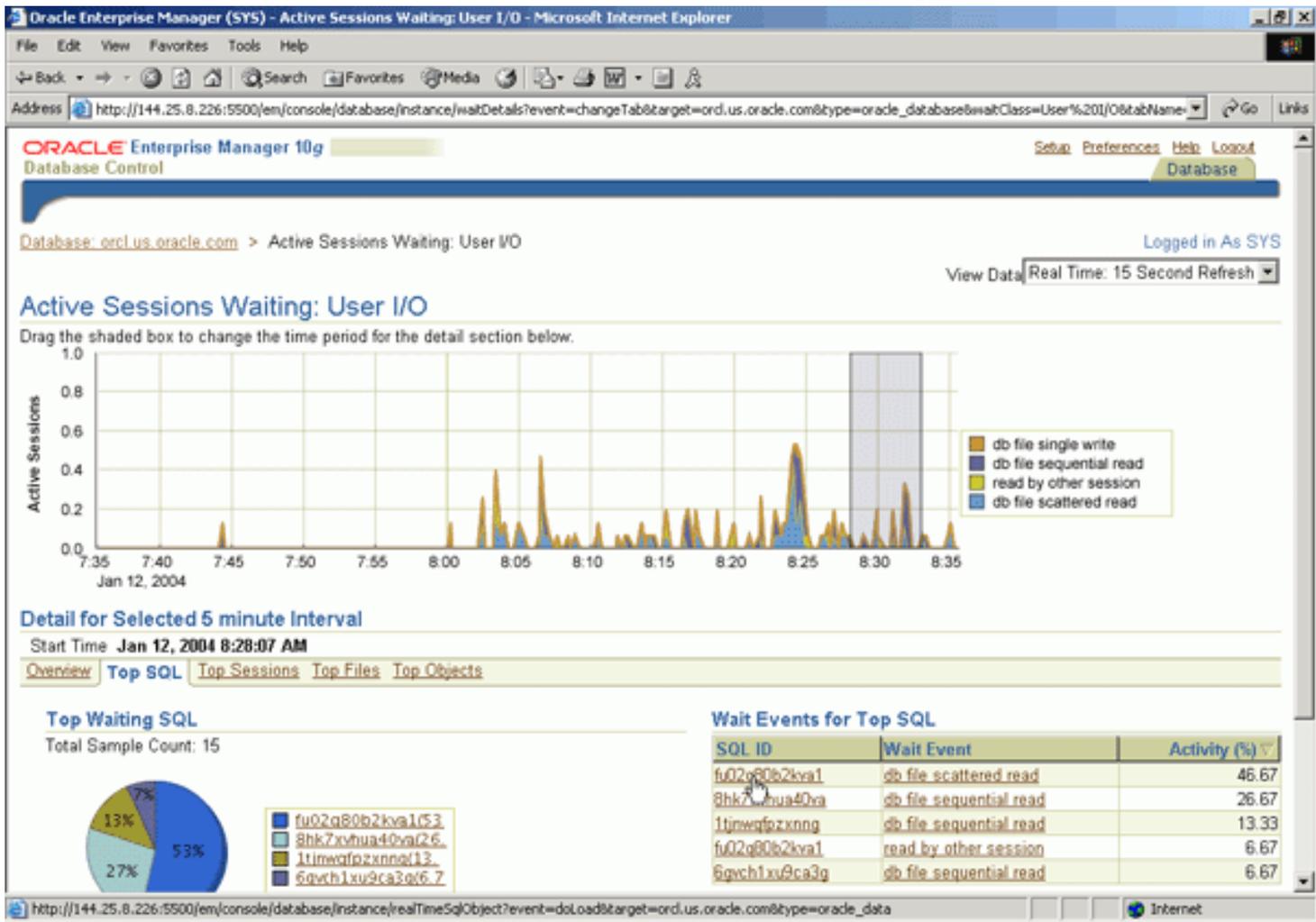
[Back to List](#)

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:

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



- 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 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`

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	255894680	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

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

The screenshot shows the Oracle Enterprise Manager 10g Database Control interface. The browser window title is "Cannot find server - Microsoft Internet Explorer". The address bar shows the URL: [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](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). The page title is "SQL Details: fu02q80b2kva1". The user is logged in as SYS.

The SQL Text is:

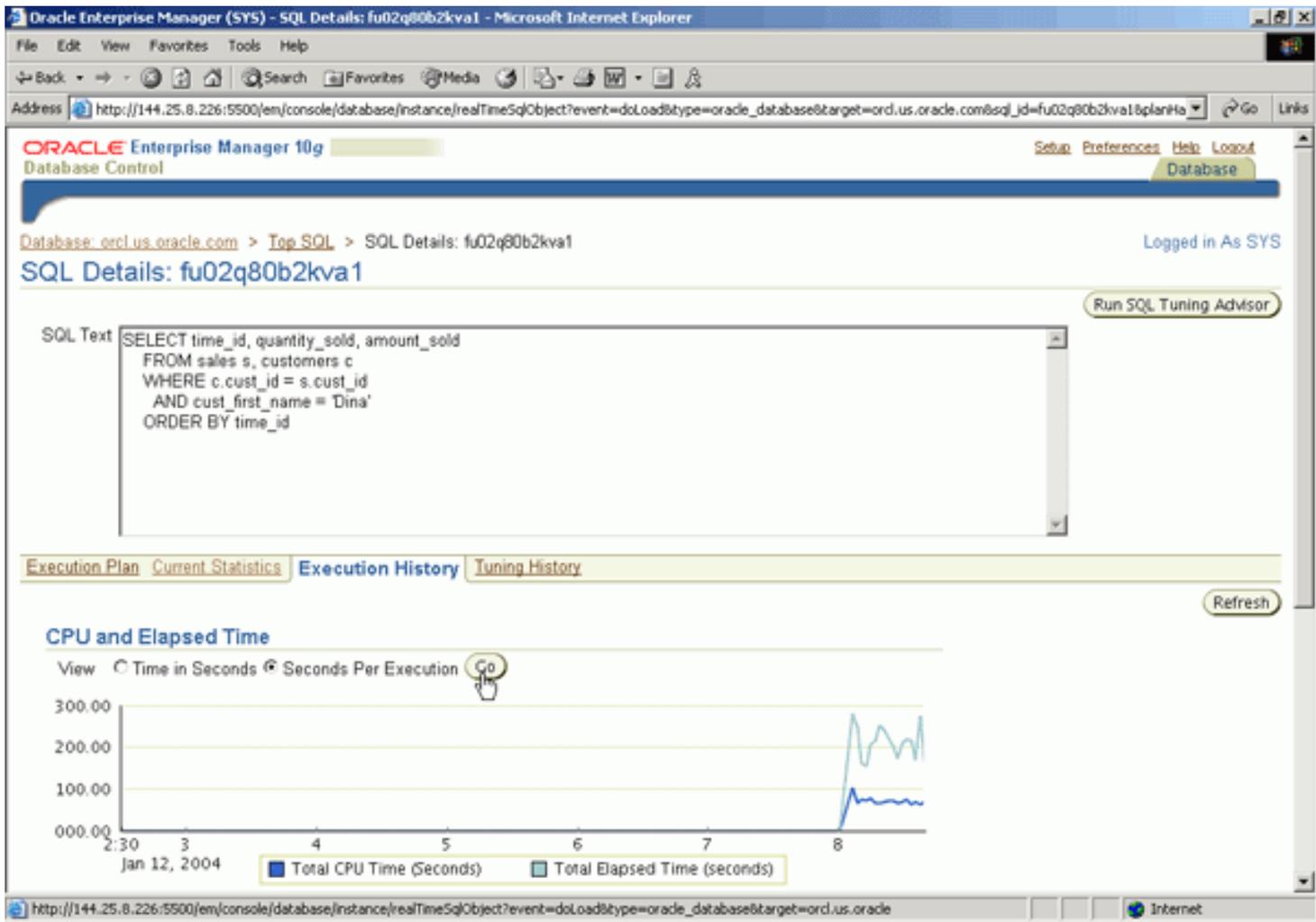
```
SELECT time_id, quantity_sold, amount_sold
FROM sales s, customers c
WHERE c.cust_id = s.cust_id
AND cust_first_name = 'Dina'
ORDER BY time_id
```

The "Executing History" tab is selected, showing the following statistics:

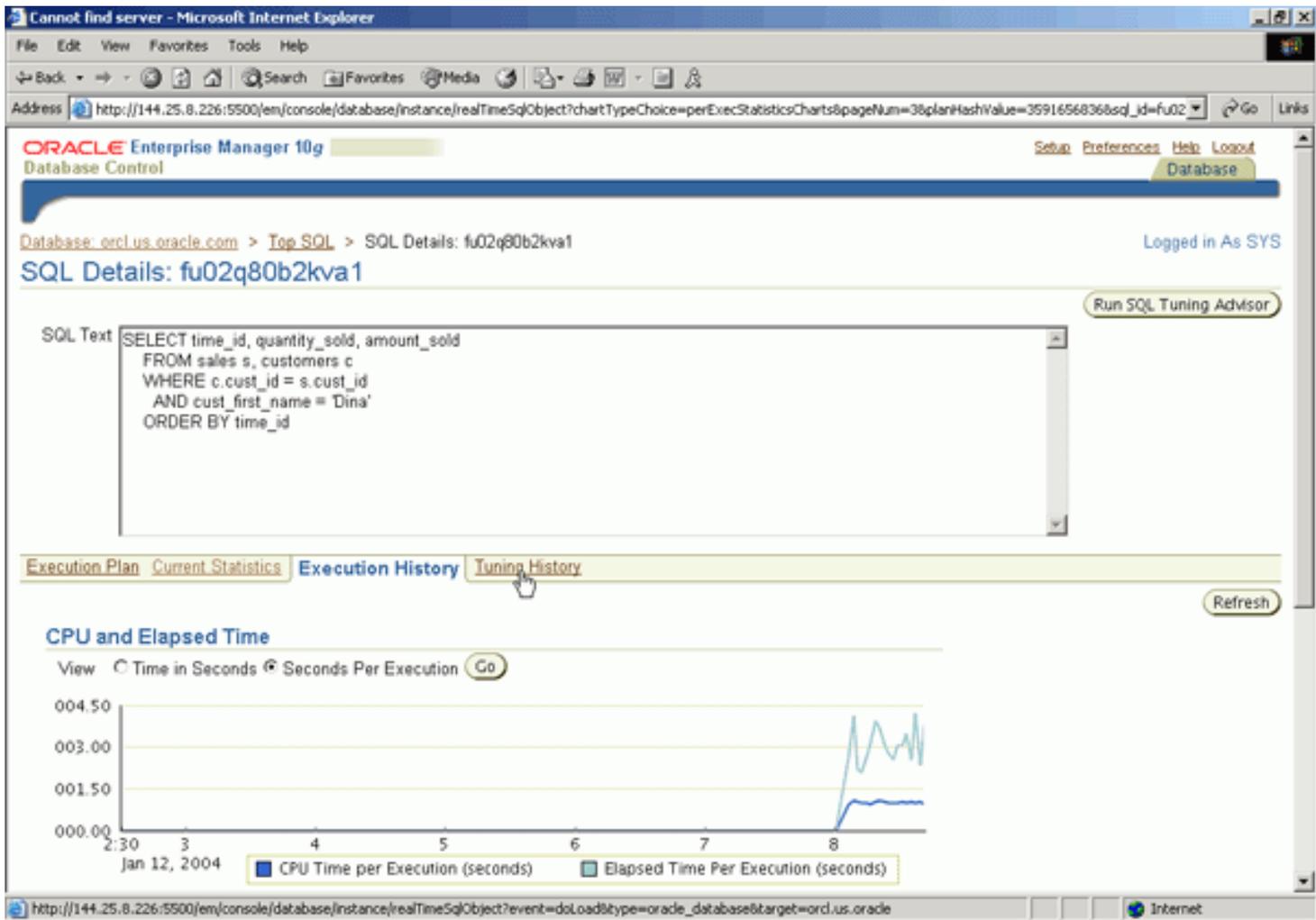
General		Execution Statistics	
Number of Execution Plans	1	Executions	1233
Program Name (Line Number)	Not Applicable	Parse Calls	1233
SQL Profile	Unavailable	Rows Per Fetch	1.0
SQL Profile Status	Unavailable	Rows Per Execution	3.0
SQL Profile Category	Unavailable	Executions Per Parse Call	1.0
Time Model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

The data was collected from the target on Jan 12, 2004 8:40:08 AM.

- 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.



- 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 10g  
Database Control

Database: orcl.us.oracle.com > Top SQL > SQL Details: fu02q80b2kva1  
Logged in As SYS

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 | 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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## Tune a SQL Statement Using the SQL Tuning Advisor

[Back to List](#)

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**

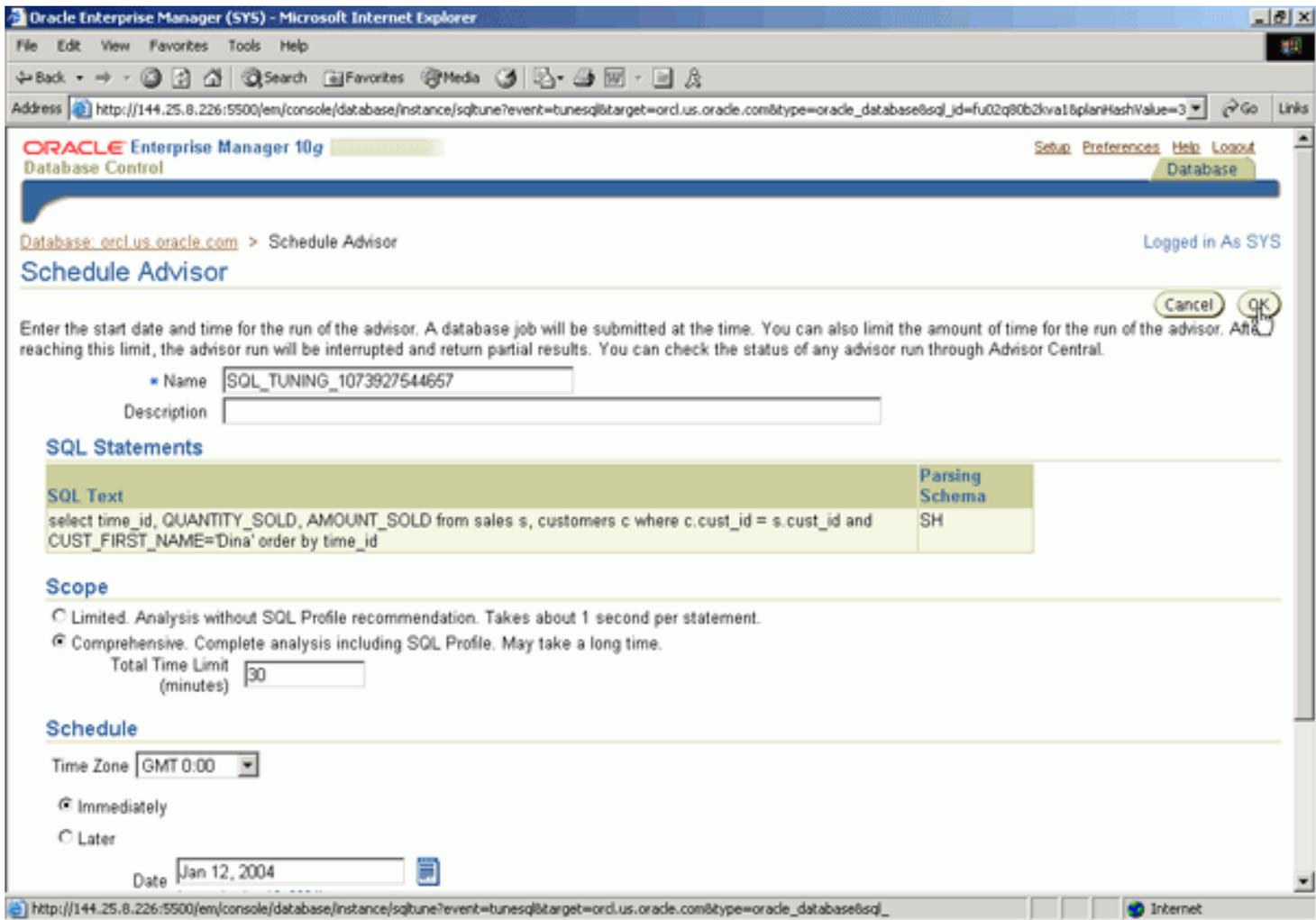
The following table lists all the recommendations available for the SQL statement.

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

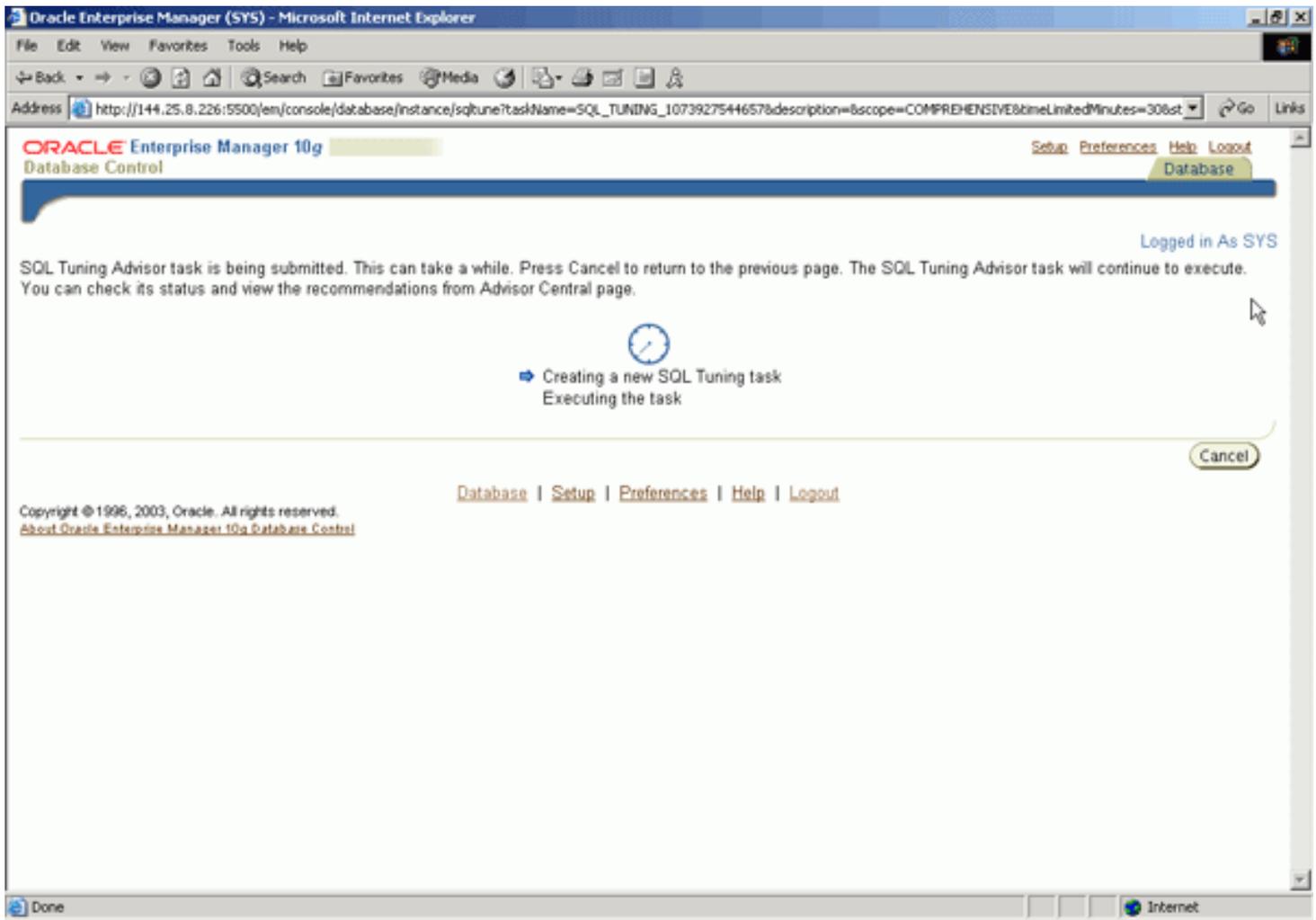
Run SQL Tuning Advisor

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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** .



- 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

Database Control

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="checkbox"/> select time_id, QUANTITY_SOLD, AMOUNT_SOLD from sales s, customers c ...		<a href="#">fu02q80b2kva1</a>		✓			

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

http://144.25.8.226:5500/em/console/database/instance/sqltune?task\_id=2346event=view\_result&advisoryCentralURL=/em/console/data

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

The screenshot shows the Oracle Enterprise Manager 10g interface in a Microsoft Internet Explorer browser. The page title is "Oracle Enterprise Manager 10g Database Control". The breadcrumb navigation 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 this, it states "Only one recommendation should be implemented." and provides the "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
```

Under "Select Recommendation", there is a table with columns: Select Type, Findings, Rationale, Benefit (%), and New Explain Plan. A single recommendation is shown:

Select Type	Findings	Rationale	Benefit (%)	New Explain Plan
SQL Profile	A potentially better execution plan was found for this statement.		99.97	<a href="#">Original Explain Plan</a> <a href="#">Implement</a>

At the bottom of the page, there is a copyright notice: "Copyright © 1996, 2003, Oracle. All rights reserved. About Oracle Enterprise Manager 10g Database Control".

- 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](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:6j02q80b2kva1](#) > [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	18,843.4614	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	1	8171		SH.CUSTOMERS_PK	INDEX (UNIQUE)	

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

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[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](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.

Oracle Enterprise Manager (SYS) - Microsoft Internet Explorer

Address: [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](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)

ORACLE Enterprise Manager 10g  
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
<input checked="" type="radio"/> SQL Profile	A potentially better execution plan was found for this statement.		99.97 <a href="#">SQL</a>

[Return](#)

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

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Address: [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](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)

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

Database: orcl > [Advisor Central](#) > SQL Tuning Results: TASK\_00048

## Confirmation

The recommended SQL Profile was created successfully.

## SQL Tuning Results

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

## Overview of recommendations

[View Recommendations](#)

Previous 1-1 of 1 Next

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

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

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## Reviewing SQL Execution Details for a SQL Statement

[Back to List](#)

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.

The screenshot displays the Oracle Enterprise Manager 10g Database Control interface for the database instance 'orcl.us.oracle.com'. The 'Performance' tab is selected, showing various performance metrics and charts.

**General**

- Status: **Up** (Shutdown button)
- 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**

Bar chart showing CPU usage for 'Other' (blue) and 'orcl' (green). The 'orcl' bar is at approximately 60%.

Run Queue: **2.8**  
Paging (pages per second): **0.0**

**Active Sessions**

Pie chart showing session status: CPU (green, 0.6), I/O (purple, 0), and Wait (yellow, 1.3).

Active Sessions: **2.0**  
SQL Response Time (%): **162.54** (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** (checkmark)
- Segment Findings: **Not Configured**
- Policy Violations: **0** (checkmark)
- Dump Area Used (%): **Unavailable**

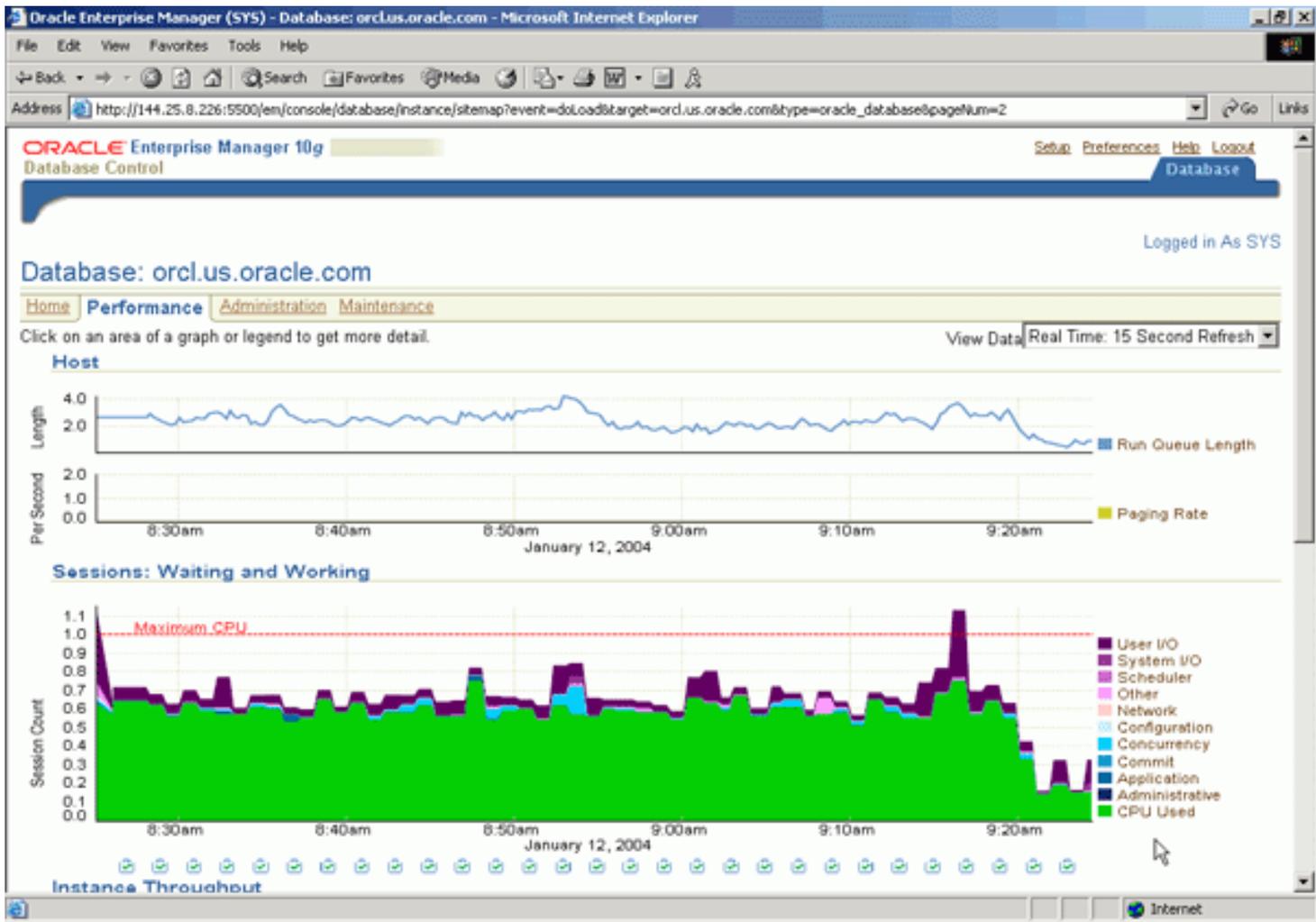
**Diagnostic Summary**

- Performance Findings: **0**
- All Policy Violations: **64** (red X)
- Alert Log: **No ORA- errors**

**Alerts**

Critical: **0**

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.