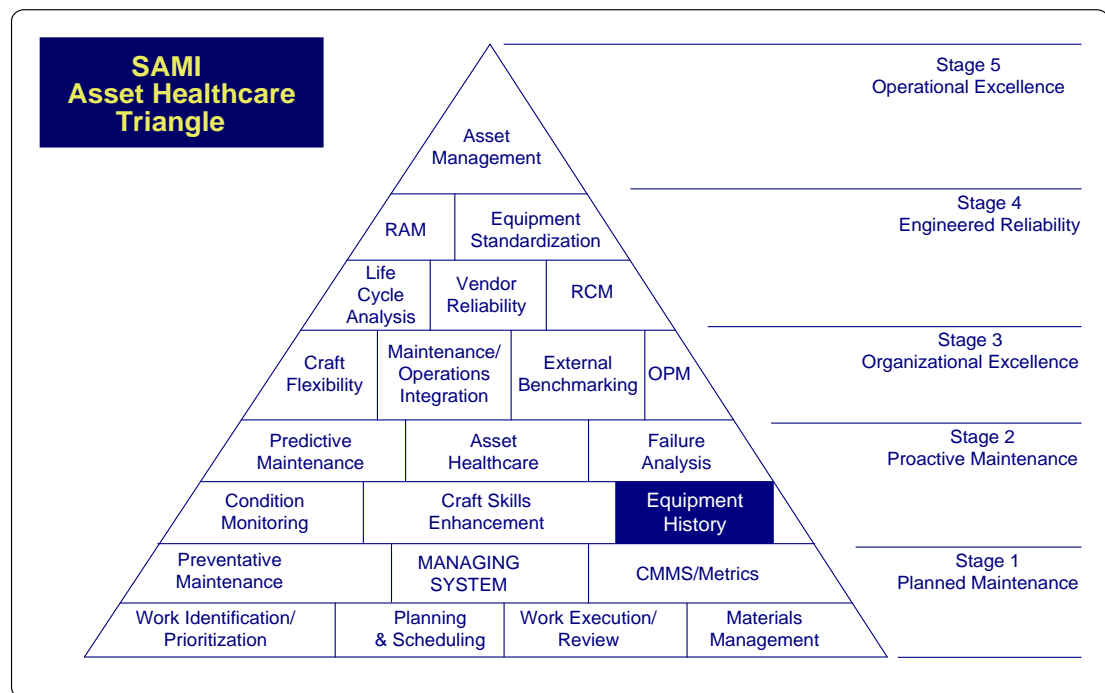


## CHAPTER 6 EQUIPMENT HISTORY

This chapter describes the equipment history block of the second stage of the SAMI triangle. This is shown in figure 58. The two preceding chapters indicated how the different systems are interfaced with the AlertManager and how symptoms and faults are generated from the different HART-enabled field devices and different plant control systems. In this chapter attention is given to the log files that indicate what symptoms and faults occurred, and the periods of time that these symptoms and faults were active. Different reports are used to retrieve information from the AlertManager that may be needed for RCFA and maintenance work processes. These various reports are discussed in this chapter.



**Figure 58: Equipment history**

### 6.1 Introduction

The work processes discussed in chapter 3 is an outflow from the actions that were followed in the action research methodology. History plays a very important role in

any maintenance work process and predictive maintenance strategies. The history information captured by the asset management system is used in maintenance plans, maintenance scheduling and process data processing. The history information is used to pin point a typical process problem and this would assist the process engineers to redesign the process, building on the history information referring to the problems that was experienced and captured in the asset management system (Joubert 2006).

Asset history is used in key performance indicators (KPI) that benchmark the equipment to a predetermine set of criteria to determine the availability of a plant and its equipment (Sasol 2006). The AlertManager have the capability to produce the required history information that is required and processed in the KPI documents. This equipment history information is also used in RCFA processes.

## **6.2 Assets information folders**

In AlertManager, the symptoms and faults and faults for a particular asset are configured. Part of the configuration includes the addition of folders that contain additional information regarding the asset. The asset folders are placed in two groups namely, Diagnostic folders and Information folders. The diagnostic folders show the following information:

- All Recommended Actions
- All Symptoms
- All Fault Models
- Related Fault Reports
- Activity log

The information folders show the following information:

- Process information
- Physical information
- Maintenance information
- Safety
- Reliability information

The reliability folder is contains the following information that allows the user to view the asset history:

- Fault Counts
- Symptom Counts
- Asset Performance

In the sections that follow these folders are discussed in further detail.

### **6.2.1 Fault counts**

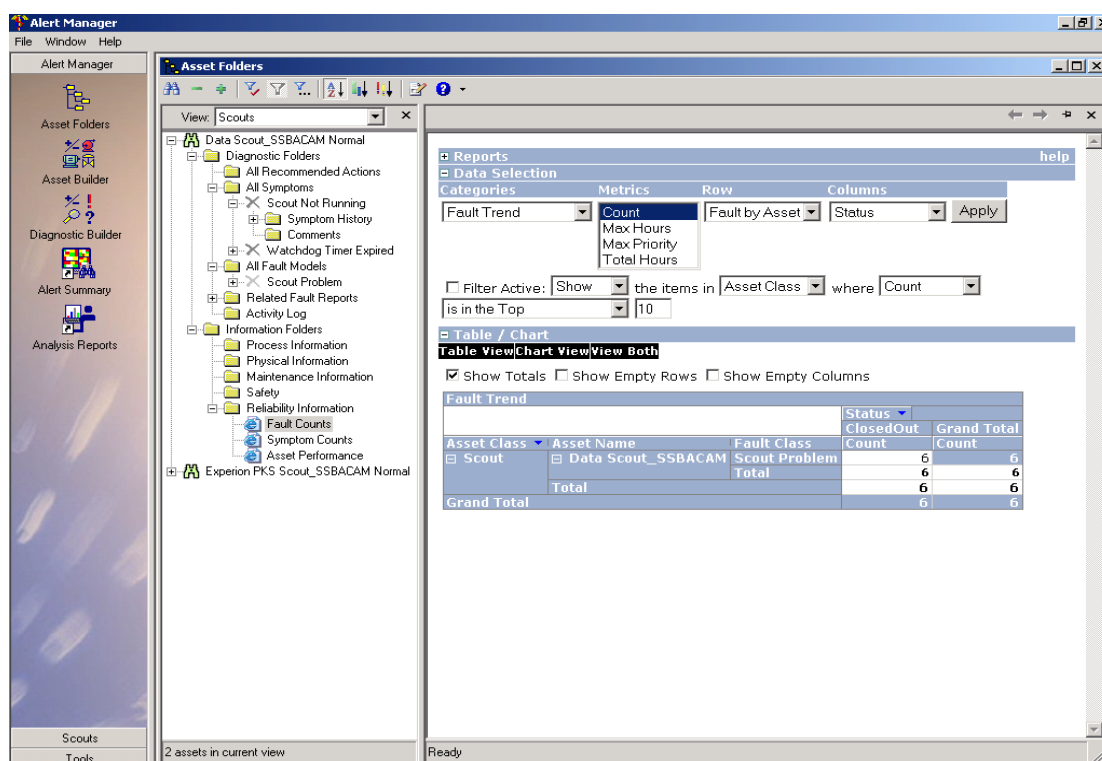
The example of the DataScout asset presented in figure 59 below indicates the faults counts that are displayed as a pre configured report.

The following parameters are selected to produce a final report:

- The report must be shown in table format.
- The fault trend with a final count of the faults per asset and the status must be shown.
- Only show the top ten faults for the specified asset.

In the table shown in the right hand pane, it can be seen that the Data Scout\_SSBACAM asset has a scout problem that has occurred six times and has

been closed out six times. This means that the fault was detected and closed out by the user that performed the maintenance on the AlertManager viewing the faults. This report is typically used in daily maintenance routines for checking faults and symptoms from the monitored devices and systems.

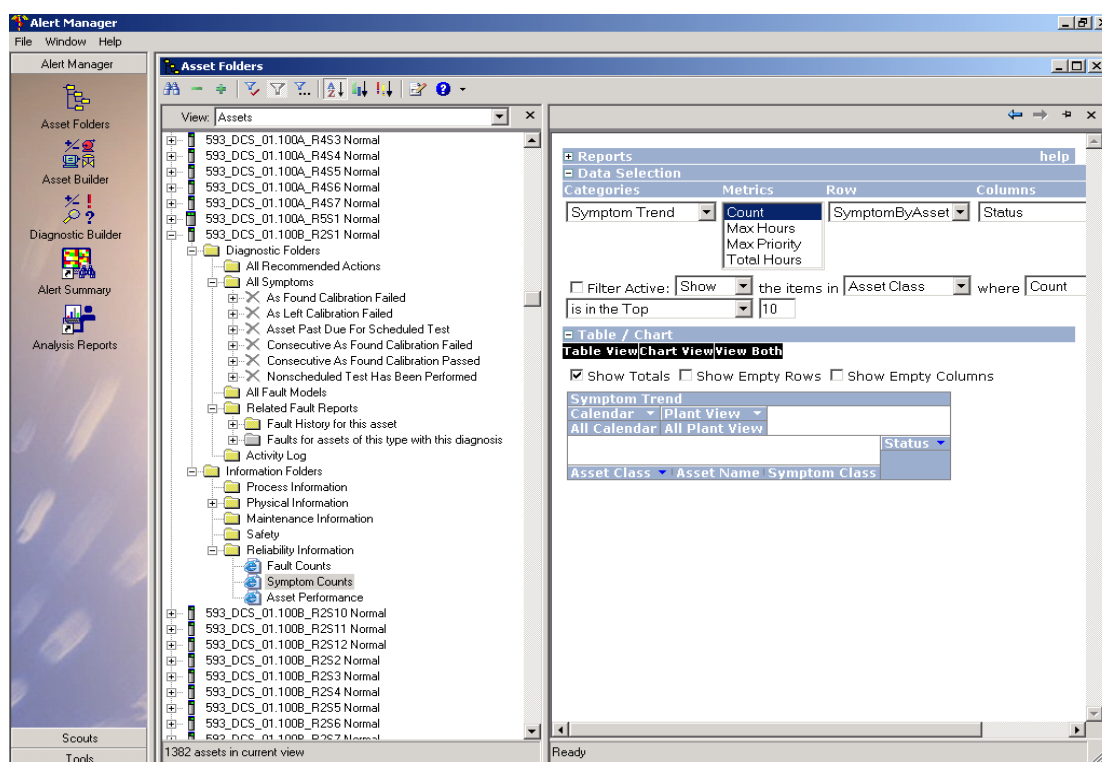


**Figure 59: Fault counts**

## 6.2.2 Symptom counts

The symptom counts item in the reliability folder is a report that can be generated by the AlertManager using the customising setup. Various options are available to setup the report that is required. The report may be generated by selecting different categories for the symptom, metrics that determine typically counts, max hours, max priority or total hours. The row and column selections can select different parameters associated with the specific symptom being chosen. Filters may be selected for more precise information and the final view can be in a table or a chart.

For this specific asset symptom there are no history data. Refer to figure 60 for the setup and typical report.

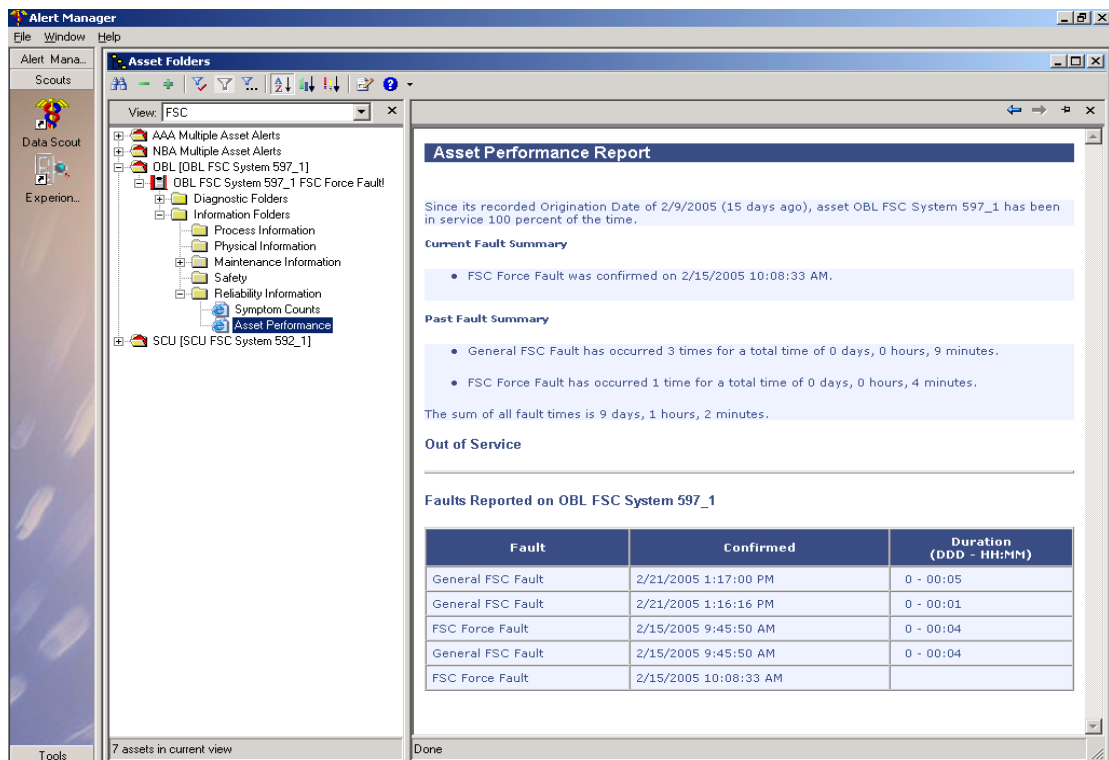


**Figure 60: Asset symptom count detail**

### 6.2.3 Asset performance report

Figure 61 shows the FSC system that is in alert. By clicking on the detail tab in the information folder, a reliability folder is revealed. This folder holds all the history information about the asset. When the reliability tab is opened, the asset performance tab is opened. All the asset particulars can be viewed by the user. On the asset performance report on the right pane of the display, all the history for this asset is displayed. The report provides a general fault summary, past fault summary and an out of service indication. It also provides a summary report of faults being reported.

For the FSC asset in the OBL area of the plant shown in this display, the different faults that were configured and discussed in chapter 4 are indicated as well as the time and date when this diagnostic information was received from the FSC system. The duration refers to how long the asset was in alarm before it was manually or automatically closed out. This type of information is crucial for the KPI document since it uses the information to populate the KPI trees in the document. Population of the KPI trees will be discussed later in the chapter.



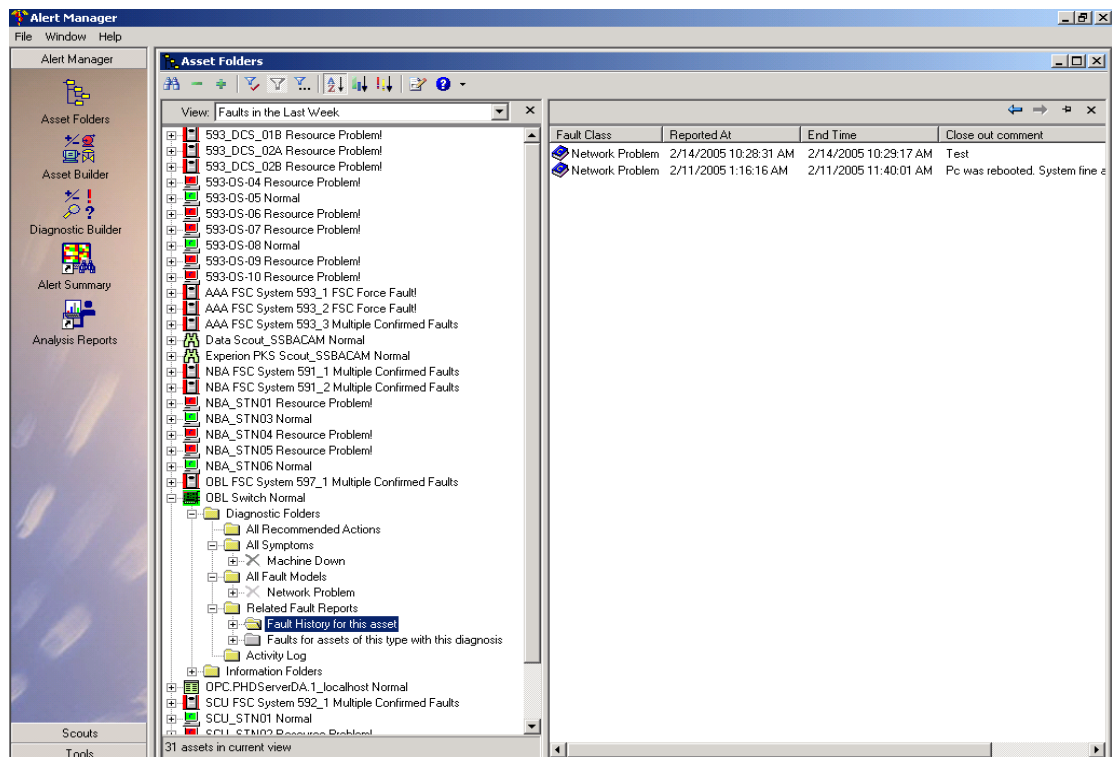
**Figure 61: Asset performance report**

#### 6.2.4 Fault History for the asset

The related faults report tab shown in figure 62, opens the tab fault history for this asset and the details are displayed on the right pane. The fault class is shown, indicating what type of fault occurred. In the example a network error is present on the OBL switch asset. The time and date that the fault was detected is indicated in

the Fault History window shown on the right of the display. The close out comment is provided in order to capture the reason for the fault being closed out.

In Figure 62, the first fault was detected when a test was performed. The second problem was identified when that particular PC was rebooted.



**Figure 62: Fault history for the specific asset**

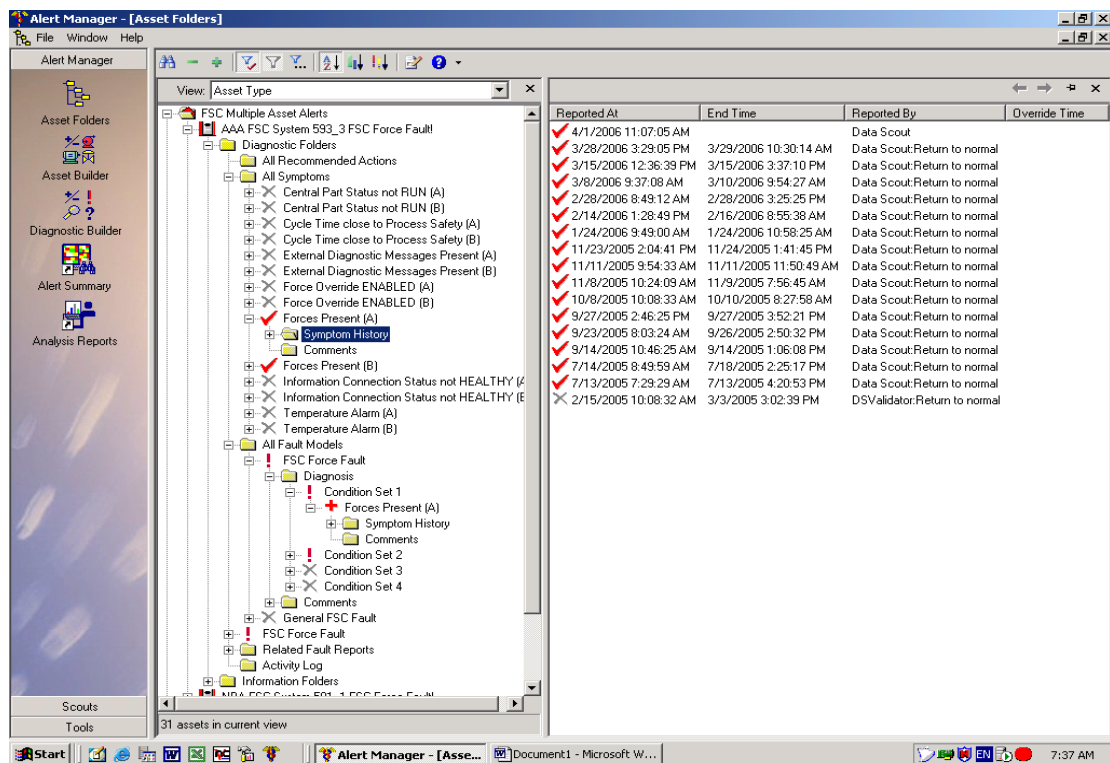
## 6.2.5 Activity log

The activity log is kept for every activity that the DataScout, APCScout and ExperionScout perform. Each entry into the log is time stamped and a description of the activity as it occurs is provided. Certain log entries indicate when the asset was configured. Configuration information is very important because the date and time is used as a reference point for the history. The Activity Log is crucial for RCFA's because every entry can be verified and checked if a problem is detected on plant, system or field equipment. An activity log is generated for every asset and this log is



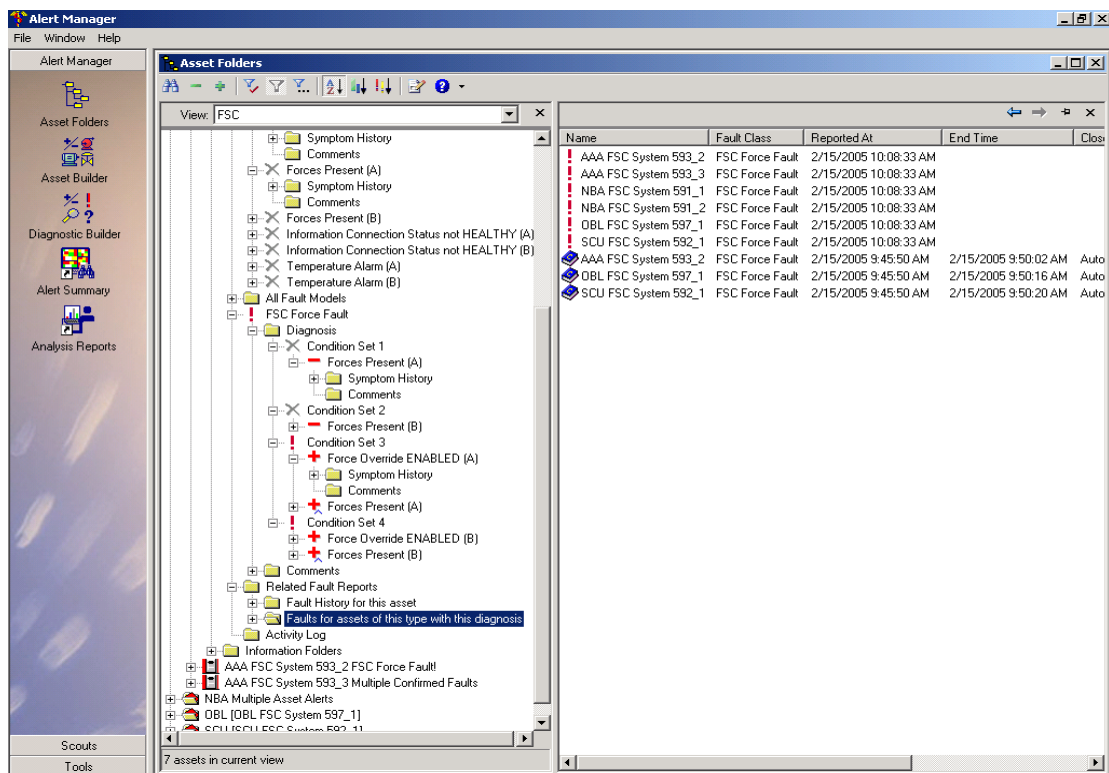


history information is part of the maintenance procedures developed to look at these faults in the AlertManager.

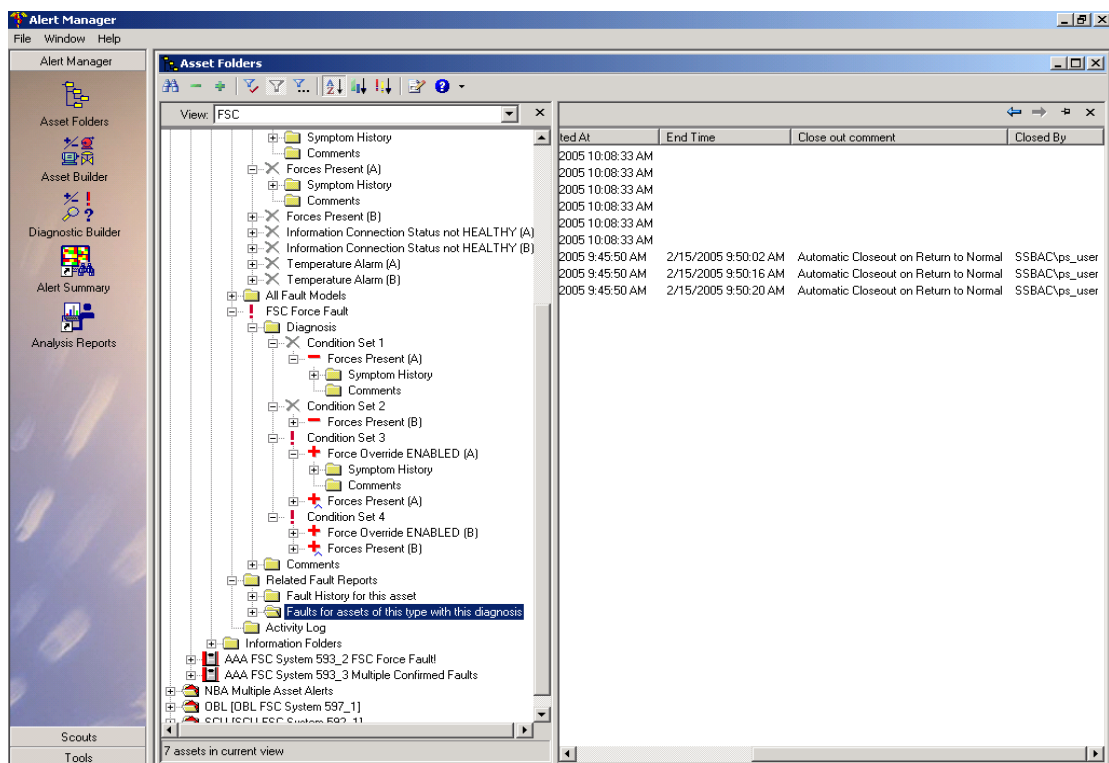


**Figure 64: Symptom history on an active symptom**

Figures 65a and 65b indicates faults for an asset with specific diagnosis. The history display is viewed over two figures to show all the related history information. This information is similar to the previous symptom history discussion but in this section the data is presented differently. The emphasis in this history information is on the same fault but for different assets. Different assets that have the same symptom activated are shown with the newest information at the top of the list. All of the assets are the same namely “FSC Force Fault”. The first six systems were detected but are still in the active state where the following three are automatically closed out by the DataScout (figure 65b) and returned to normal.



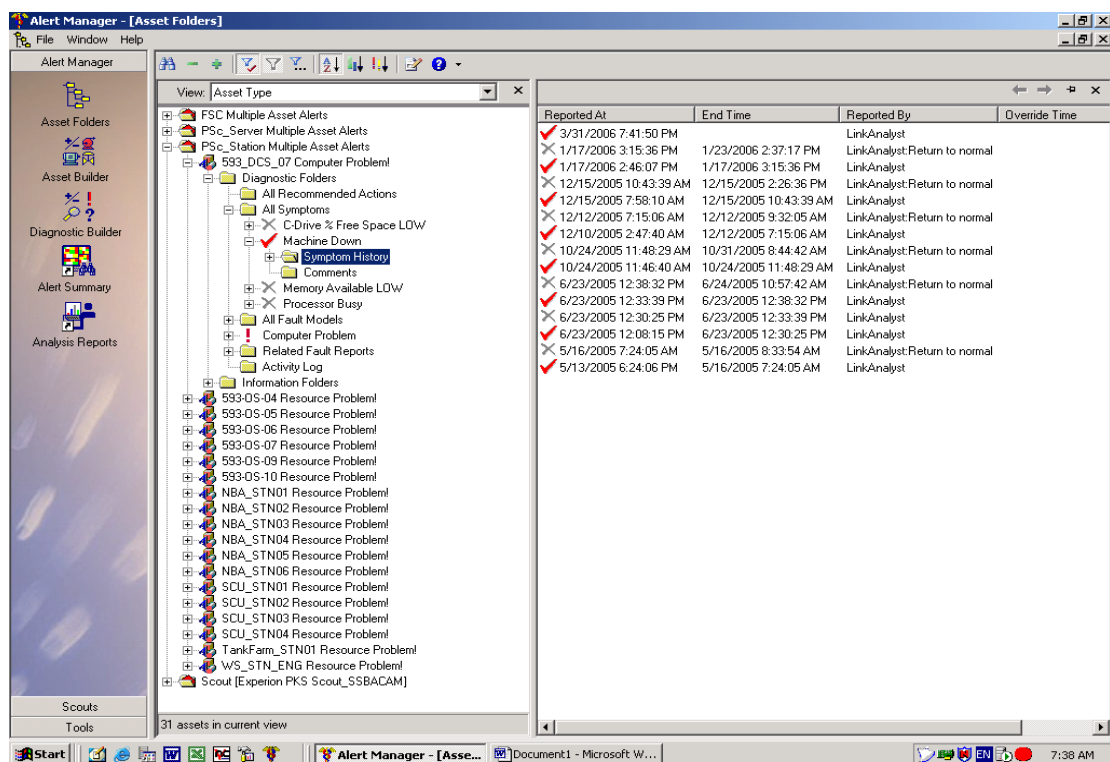
**Figure 65a: Fault for asset with specific diagnosis – part 1**



**Figure 65b: Fault for asset with specific diagnosis – part 2**

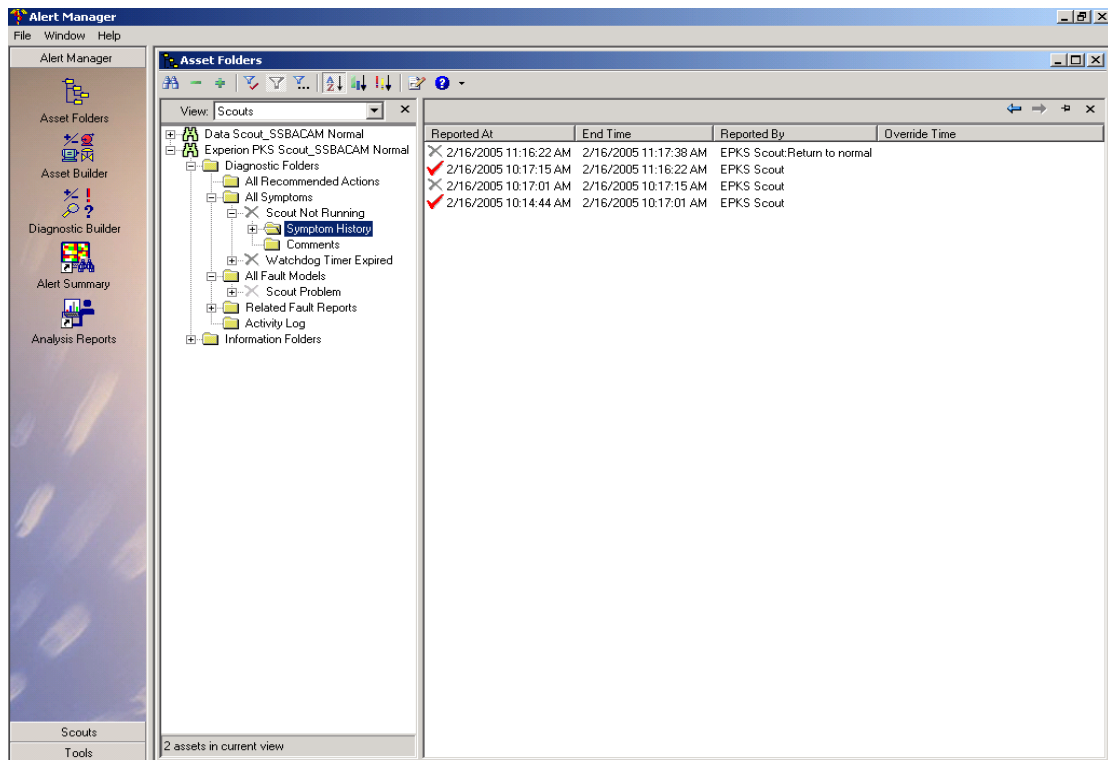
These assets were closed out by the SSBAC\ps\_user. The same user that was configured for the DCS, OPC clients, DataScout, ExperionScout, APCScout, LinkAnalyst and AlertManager is used to ensure that the access privileges and access is the same for all systems.

For the PSc\_Station asset in figure 66 where the machine down symptom is activated by the Link Analyst software, it indicates the alert was reported by Link Analyst. When the fault condition was returned to normal in the Link Analyst software, it was then reported via the DataScout and in the history shown as reported to normal.



**Figure 66: Symptom history with LinkAnalyst symptom diagnostic**

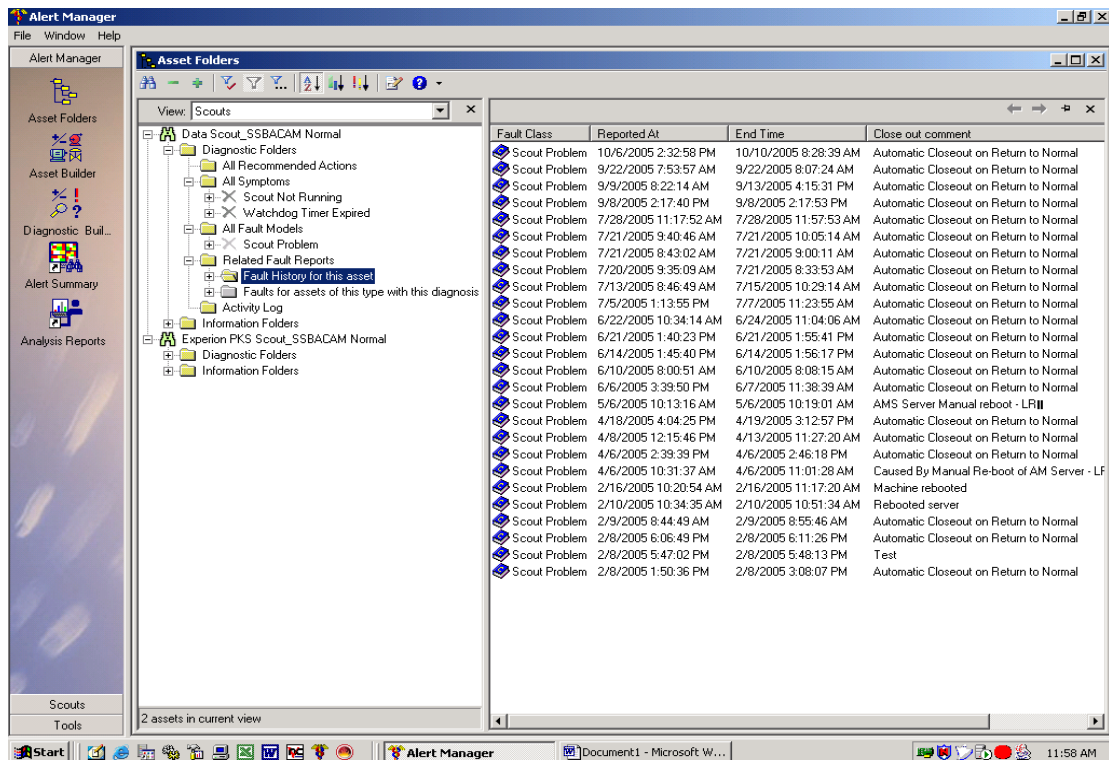
In the following figure the ExperionScout details that reported the alert is shown. This interface is reporting activities within the interface with the time stamp information on what happened when. When the ✓ on the left of the time stamp is shown, it indicates that the symptom is present but if the time stamp is with a ✗, it indicates that the fault is not present.



**Figure 67: Symptom history with Experion Scout**

### 6.2.7 Fault history for the asset

Fault history information is available under the related faults report for the specific asset. The history information is only applicable to the asset which is the DataScout. In the example shown in figure 68 the right pane is split up in the fault class, reported time, time the problem stopped and the close out comments. From the log entries it can be seen that the DataScout returned to normal under normal conditions but there were problems when the server was rebooted. The blue book on the left side of the log entry indicates that the user was required to insert a comment before the DataScout would return to normal. From this it is also possible to see who closed out a fault and why was it closed out. This option allows the administrator to monitor close outs.



**Figure 68: Fault history for a particular asset**

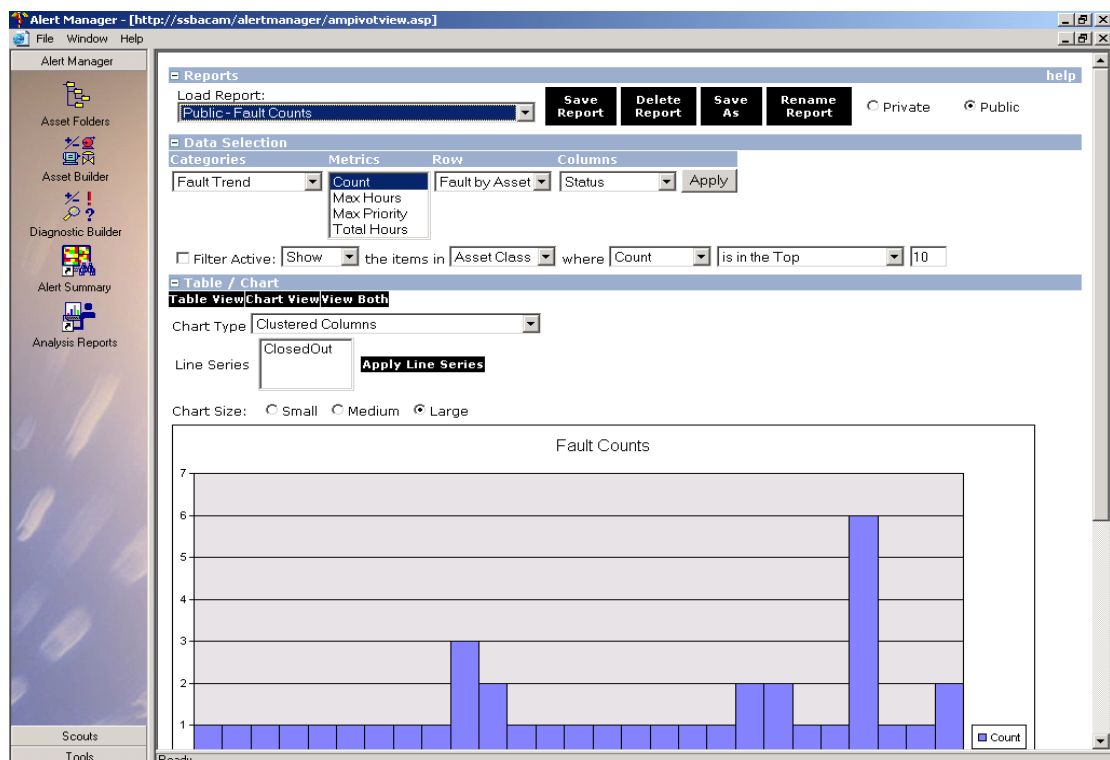
### 6.3 Reports

From the above discussions it could be seen that lots of history information is generated by the assets. For keeping track of what is happening with the different assets and their activities it is necessary to look at this data in a format that means something to the maintenance staff and especially the maintenance manager and reliability engineers.

Different reports can be generated using a web-based reporting tool that allows you to capture data within the Alert Manager database and view it in various forms (i.e., table, chart, or both). The following section will look at some of the reports and how they are generated. These reports will be used in the KPI documents, maintenance plans and procedures, scheduling of work for the maintenance group and daily asset health reporting the status of the plants and all of its systems and equipment.

Reports may be configured and saved as a preloaded report that can be selected at any stage. When a new report is generated several parameters are chosen to configure the report. These parameters are used as drop down items from where the selection is made. The data Selection section in the report allows the choice of different data to be displayed and selected from the AlertManager database.

There are different categories e.g. Fault trends and Faults per assets. Metrics gives the choice of what needs to be displayed in value such as a final count, maximum hours and maximum priority to total hours. The row and column selections determine how the data will presented in a table format. Filters are used to view only filtered data that are configured. In this example the filter is disabled. Table / Chart selection gives the choice of how the user wants the asset data to be displayed. It also gives a selection of the chart type that the data will be displayed in. The example shows clustered columns. If the report is saved the user must also decide if the data must be private or made available for web based users (public bullet).



**Figure 69: Report parameters**

### 6.3.1 Symptoms per asset type (monthly) report

The first report that is produced for maintenance purposes is the Symptoms per asset for a month report. This report looks at the symptoms per asset and where they are located in a specified area as previously discussed. In this figure the report is generated for areas such as the AAA equipment room, the control room and the other configured areas. The legend shows the different assets and how they are reported in the report. In the main graph the totals are displayed. This report is only represented as a graph.

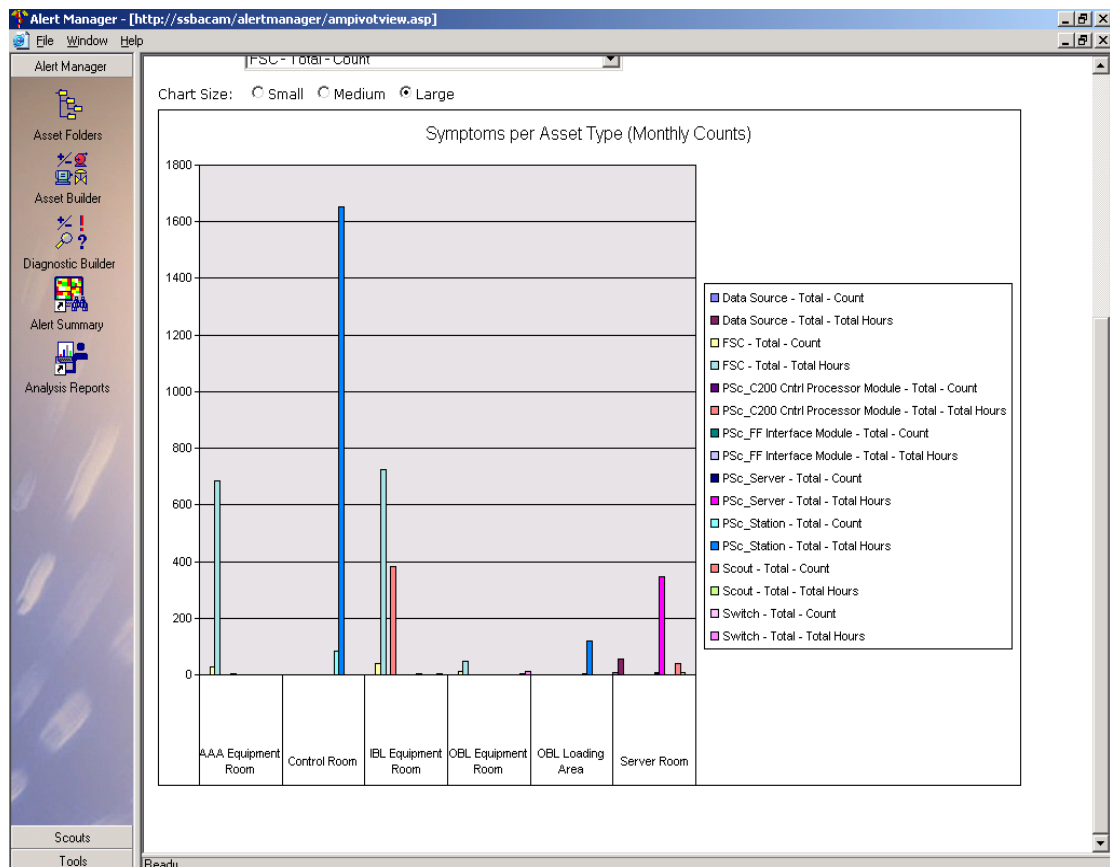


Figure 70: Symptoms per asset type monthly report



### 6.3.2 Fault Count Report

Table 10 shows a typical table view of faults per asset. It also shows the closed out status as well as the confirmed and grand total values for these assets. This report was generated in AlertManager and then exported to Microsoft Excel. Excel data is used to import this information into the KPI document that will be discussed in a later chapter.

**Table 10: Table view of an asset fault report**

| Count                | Status      |           |               |
|----------------------|-------------|-----------|---------------|
| Asset Class          | Closed Out  | Confirmed | Grand Total * |
| E+H_MicroPilotM      | 6           |           | 6             |
| E+H_Promass83        | 39          |           | 39            |
| E+H_Prowirl70        | 4           |           | 4             |
| Fisher_DVC5000       | 1           | 1         | 1             |
| Fisher_DVC6000       | 100         |           | 100           |
| FlowServe_Logix1200  | 13          |           | 13            |
| FlowServe_Logix500   | 25          |           | 25            |
| FSC                  | 196         |           | 196           |
| KROHNE_BM102         | 151         |           | 151           |
| KROHNE_BM70          | 179         |           | 179           |
| KROHNE_ESKII         | 39          |           | 39            |
| Magnetrol_ES MOD     | 3           |           | 3             |
| Masoneilan_SVI       | 1243        |           | 1243          |
| MicroMotion_1700IS   | 25          |           | 25            |
| Rosemount_3051       | 756         |           | 756           |
| Rosemount_3144       | 47          |           | 47            |
| Rosemount_644        | 81          |           | 81            |
| Rosemount_8800       | 1           | 1         | 1             |
| Saab_Level           | 7           |           | 7             |
| <b>Grand Total *</b> | <b>3664</b> | <b>2</b>  | <b>3666</b>   |

Figures 71a and 71b shows a typical fault count report that is used in the KPI document for trending the faults in particular areas of the plants. Only five assets were selected for this report and for each of the assets the faults associated with the asset are shown. The final count for the faults is presented as a count value. The report is shown as a graph and table. The table is presented in figure 71a.



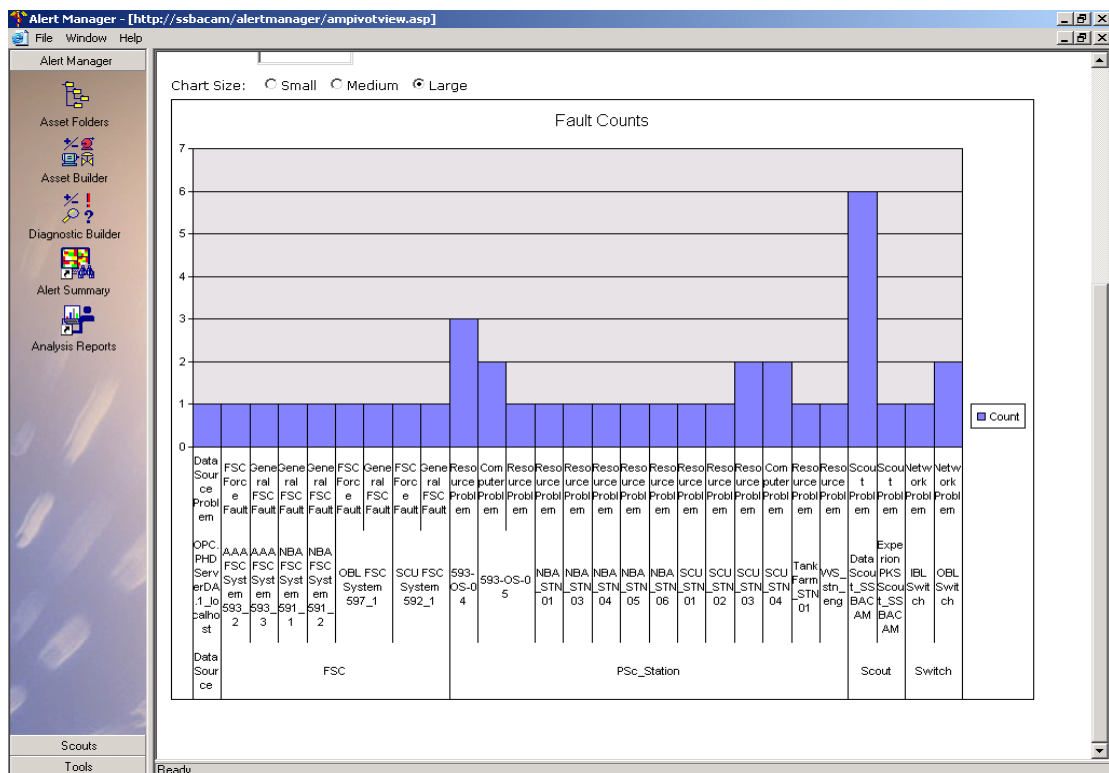


Figure 71a: Fault count report – part 1

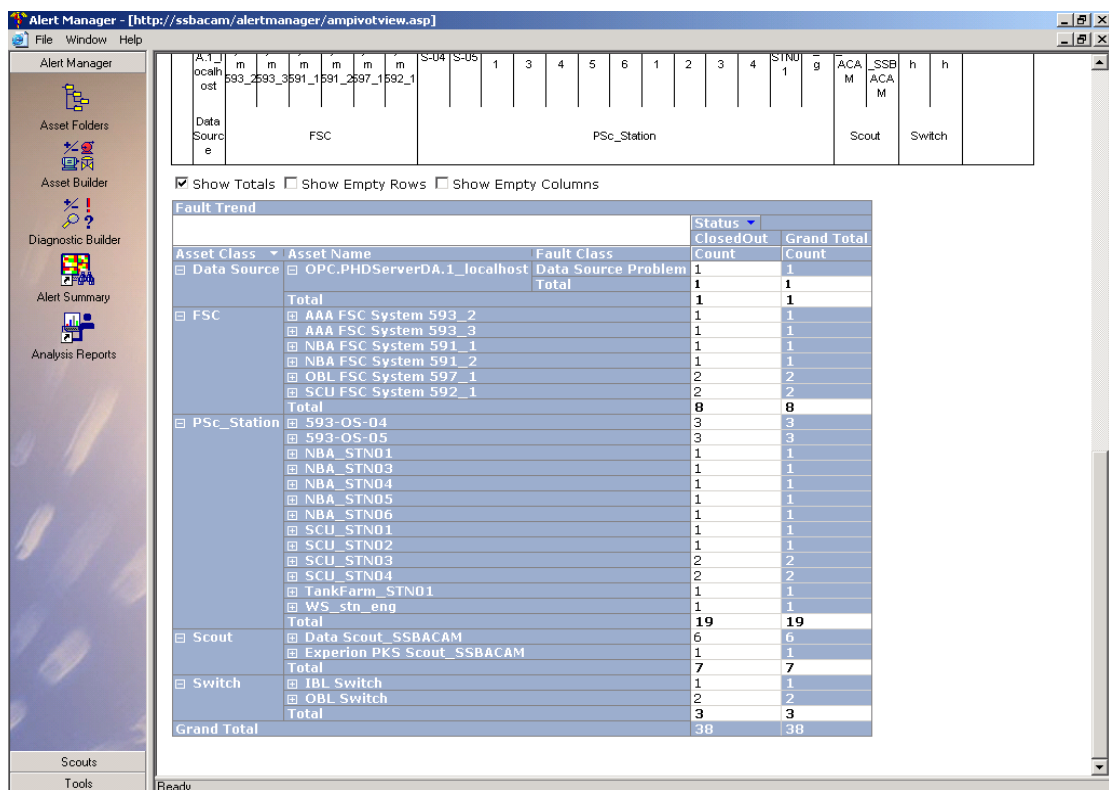


Figure 71b: Fault count report – part 2

The same data is presented in a way that it can be used in the exported report in Excel. The totals block was selected in the configuration to display the final count values. Note in the table display, the assets may be extended to get more detail. This is done to be able to show all the applicable data associated with the asset and the faults for the asset.

### 6.3.3 Number of assets per type report

The Number of Assets per Type report is used to see what equipment assets and how many assets are configured. This information is used to determine the amount of I/O that must be divided between the available artisans on the plant. This criterion is used in the Sasol Solvents environment to determine the work load for artisans. Typically seven to eight hundred I/O per artisan is the allowable work load.

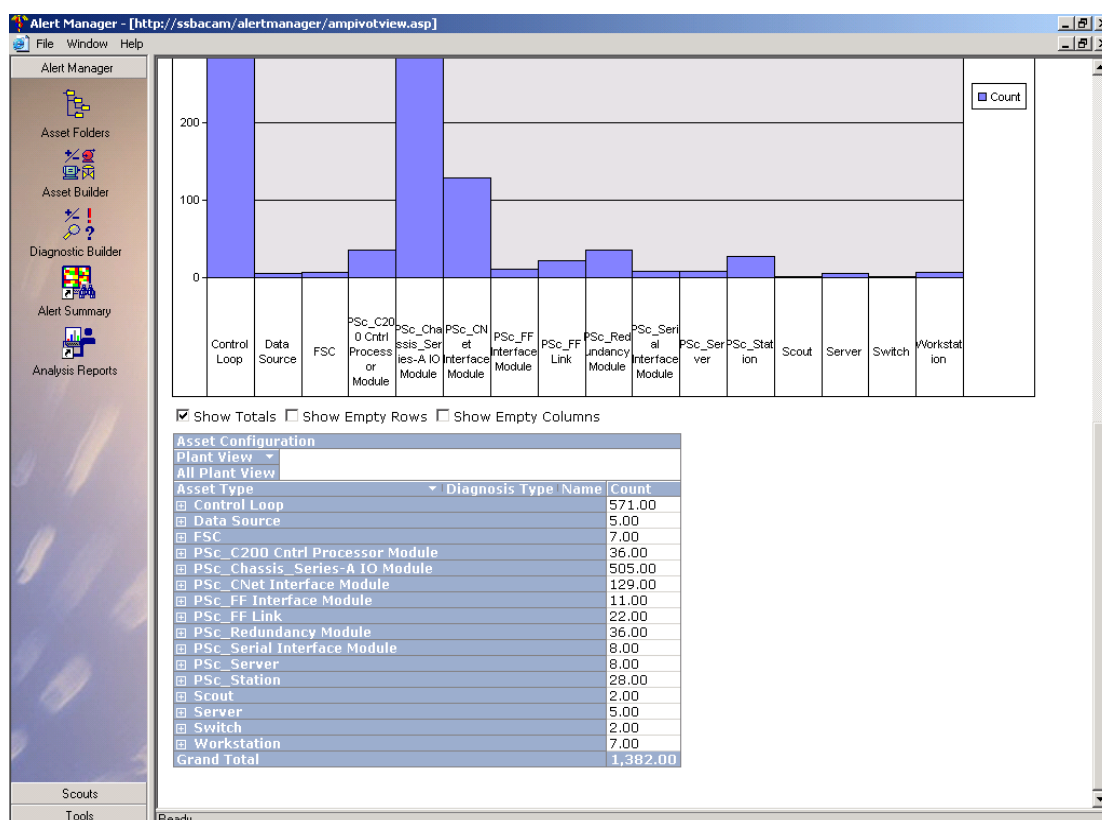


Figure 72: Number of assets per type report

### 6.3.4 Different graph representations

Figures 73, 74 and 75 are different reports where the graph is represented in different formats. Depending on the requirements from the AlertManager users, the types of graphs can be chosen to fit the required need for data representation. The report in figure 73 shows the monthly detail for the year 2005. It indicates the symptom counts per asset for the period January and February. Figure 74 presents the data in a pie graph to indicate what percentage is represented by the different configured assets per type.

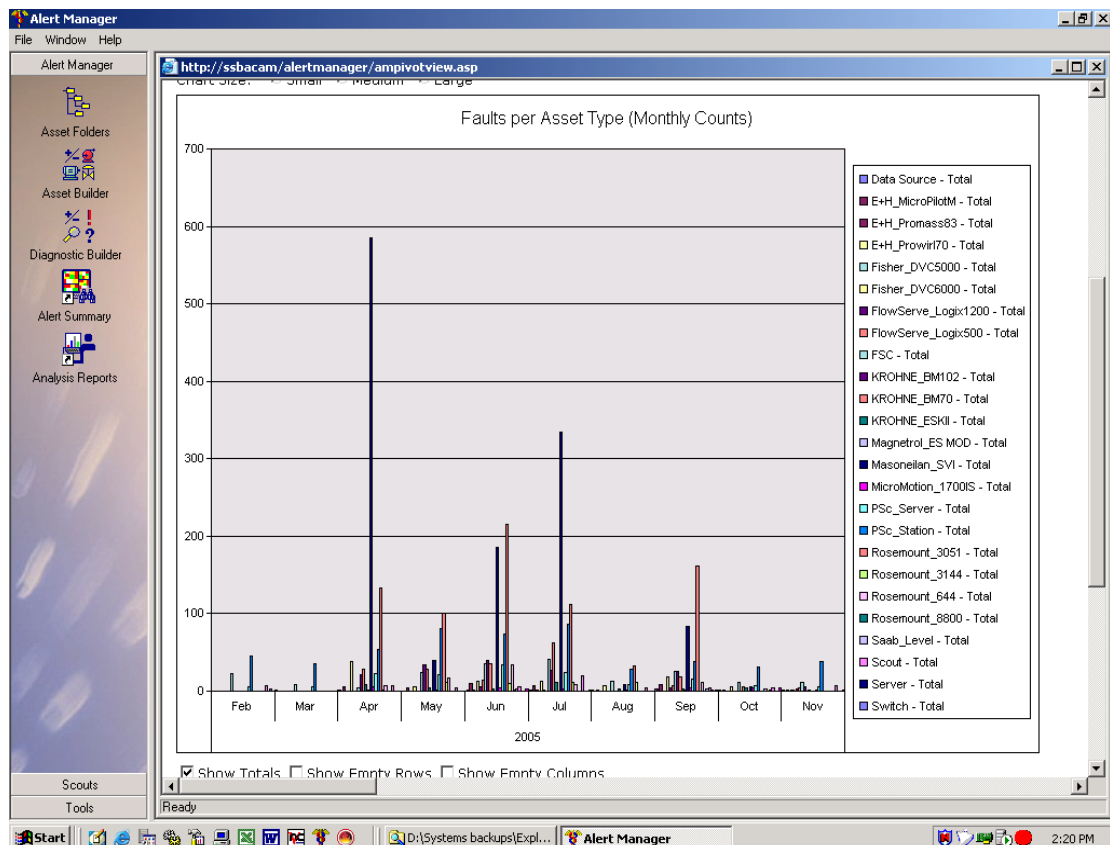


Figure 73: Symptom per asset type – month report

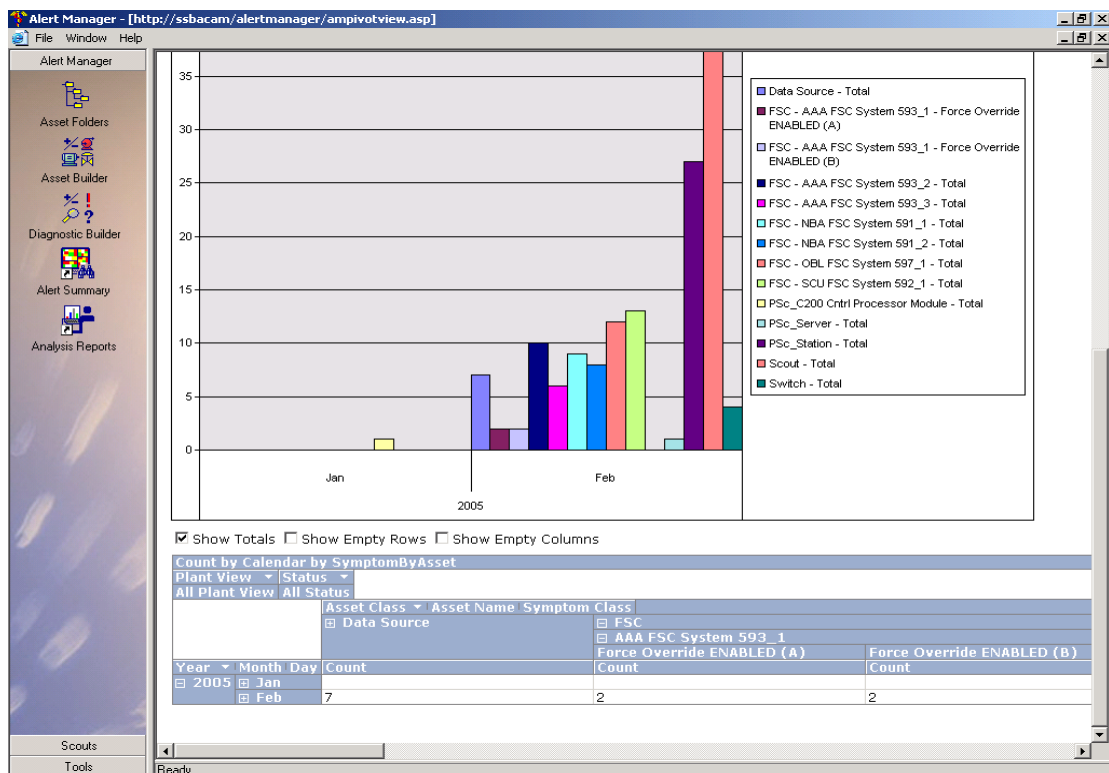


Figure 74: Count by calendar by symptom per asset report

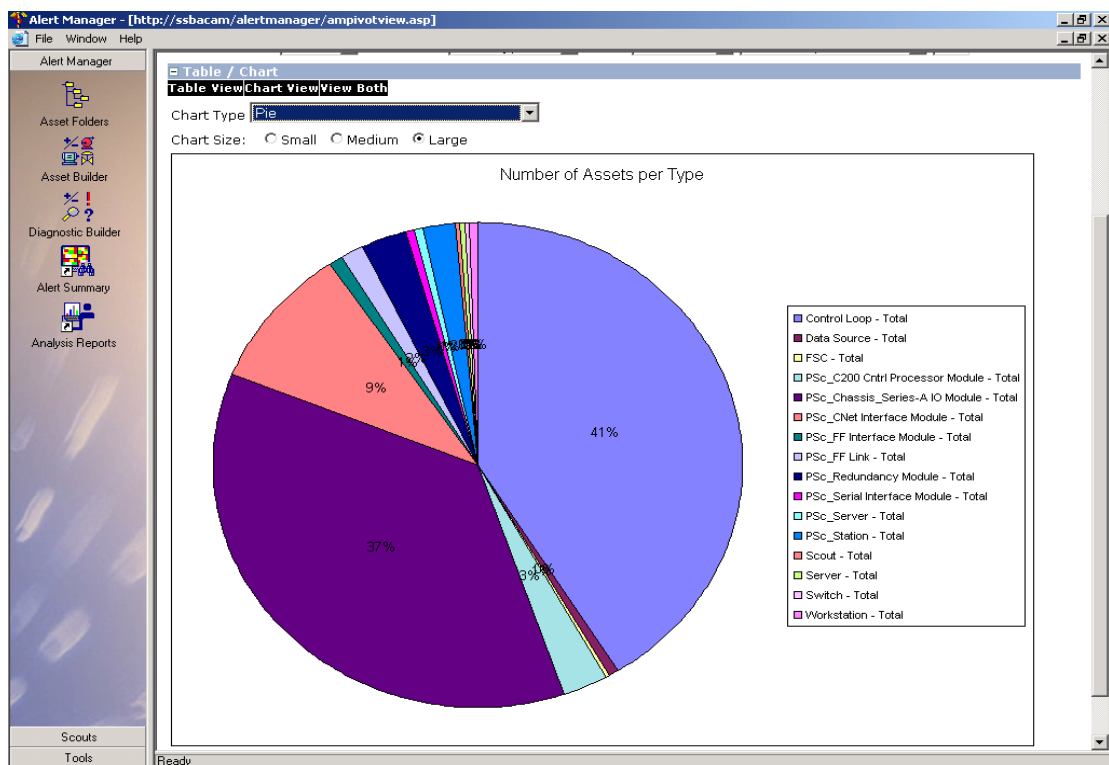


Figure 75: Number of asset per type – pie report

## **6.4 Key performance indicators (KPI)**

The abundance of information that is available through the different reports and history of plant assets requires that this information is used in a manner that will allow plant personnel to view the health of plants assets and to benchmark these assets against the world's best operating plants.

It was necessary to design a measuring mechanism by utilising key performance indicators. This mechanism can measure the monthly availability of plants assets, the history of monthly availability over a one year period, the mean time between failures (MTBF) and mean time between interventions (MTBI) on the assets. In addition, services that are provided to Sasol by contractors such as Honeywell SA may be monitored over a period to ensure that the service is up to standard.

The KPI trees are designed to utilise all data from the AlertManager into different system KPI worksheets in the global KPI worksheet. The following systems are represented in the spreadsheet using the history data:

- KPI Index – reference link to all the sheets
- Global KPI – all the different systems are represented in one sheet
- PlantScape KPI – all four DCS systems are represented
- PHD KPI – data accuracy and availability of the PHD system
- FSC – all seven systems are shown
- AMS – all field assets managed by this software
- AlertManager – all the systems that are interfaced to the software
- LoopScout – reports showing the status for each control loop

The complete KPI tree is shown in Annexure A. LoopScout reports will be discussed in chapter 7.

## **6.5 Conclusion**

This chapter described the different history information available to determine what the health status of the plant assets are. The history captured by the AlertManager is of essence since this information will be used in different processes like root cause failure analysis (RCFA) and maintenance plans. Maintenance managers will be able to view their plant health from the different views that were presented.

The developed KPI's using the history information in the exported Excel sheets was shown and this would allow the maintenance departments to monitor their asset availability over certain periods of time from service providers and equipment suppliers. The next chapter will address the craft skills enhancement block in the SAMI model where access to maintenance procedures, data sheets and other plant related data information would be granted to plant personnel.