SAS® Grid Administration Made Simple

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ABSTRACT

Historically, administration of your SAS® Grid Manager environment has required interaction with a number of disparate applications including Platform RTM for SAS, SAS® Management Console, and command line utilities. With the third maintenance release of SAS® 9.4, you can now use SAS® Environment Manager for all monitoring and management of your SAS Grid. The new SAS Environment Manager interface gives you the ability to configure the Load Sharing Facility (LSF), manage and monitor high-availability applications, monitor overall SAS Grid health, define event-based alerts, and much, much more through a single, unified, web-based interface.

INTRODUCTION

The purpose of this paper is to provide an overview of SAS Grid administration in SAS 9.4M3. As compared to previous releases, the SAS 9.4M3 release provides a "one-stop shop" for SAS Grid administration through the use of SAS Environment Manager.

This paper will begin with a brief overview of the two software applications that make up the SAS Grid administration environment in SAS 9.4M3, followed by a closer look at the features and functionality provided by these packages.

OVERVIEW

With the release of SAS 9.4M3, your SAS Grid can now be administered through SAS Environment Manager. This is made possible by the following two software applications:

- SAS Grid Manager Module for SAS Environment Manager
- SAS Grid Manager Agent Plug-in for SAS Environment Manager

SAS GRID MANAGER MODULE FOR SAS ENVIRONMENT MANAGER

The SAS Grid Manager Module for SAS Environment Manager (referred to in this paper as the "module") is a stand-alone web application that consists of both server-side (Java) and client-side (JavaScript) pieces. The server-side portion of this application is deployed in a SAS Web Application Server running in the SAS Middle Tier. The client-side portion runs in a web browser.

The module is normally launched from the SAS Environment Manager Administration tab. (See Figure 1.) However, the application can also be accessed directly. The primary use case for launching the application directly is to provide end-users with the ability to check the status of their own Grid jobs without giving those users access to SAS Environment Manager.

The module provides many of the capabilities previously available through Platform RTM (part of Platform Suite for SAS) including LSF configuration management, high-availability configuration management, Grid monitoring, and Grid management.
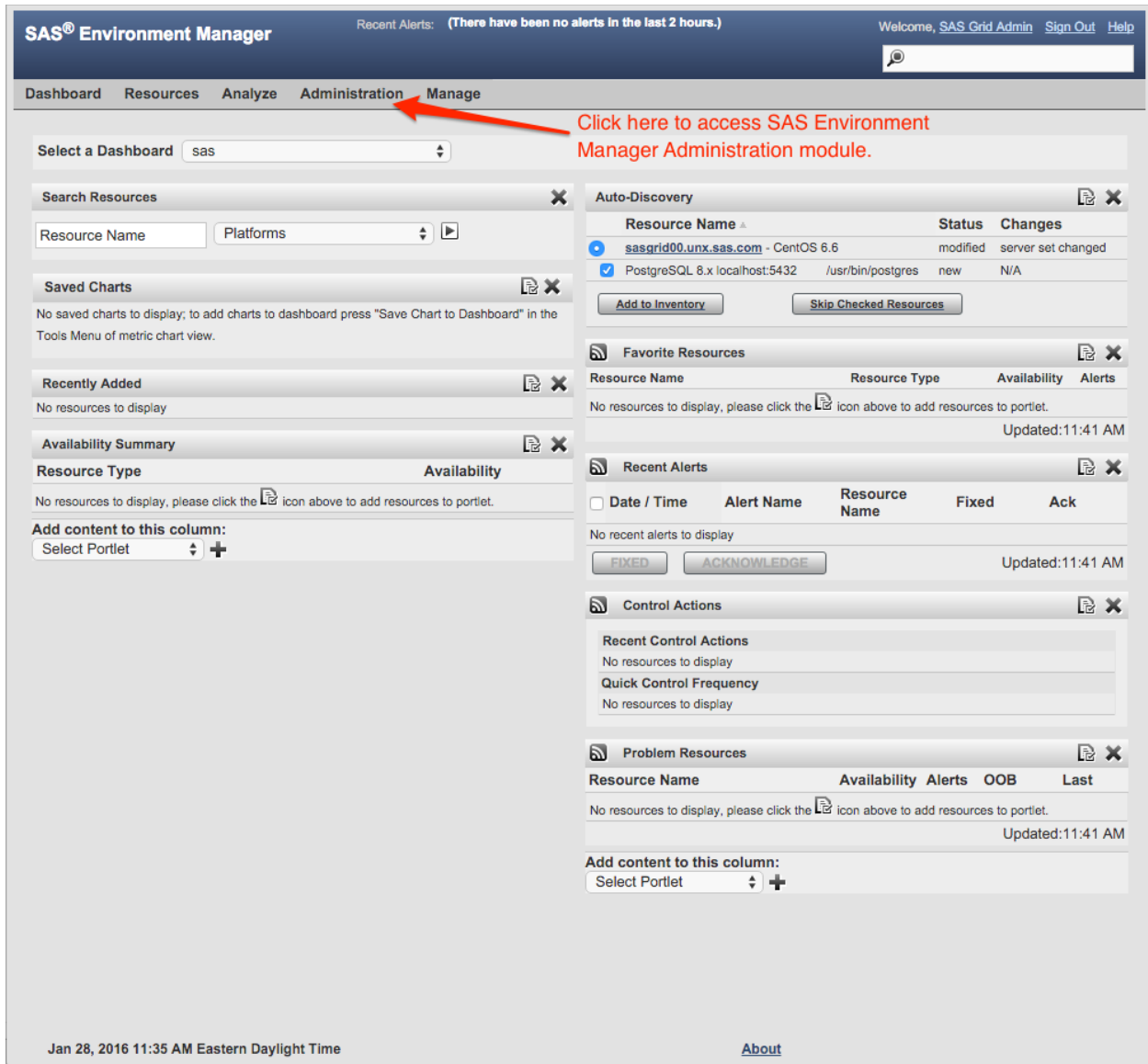
Figure 1: SAS Environment Manager Administration Tab

SAS GRID MANAGER PLUG-IN FOR SAS ENVIRONMENT MANAGER

SAS Environment Manager is designed with a pluggable architecture. One type of plug-in supported by SAS Environment Manager is known as an agent. Agents are small software bundles (typically distributed as JAR files) that run on each host or machine within a SAS deployment. Typically, agents collect information about the host on which they are running and report that information back to the SAS Environment Manager server, where it can be used for a variety of purposes including graphing, alert generation, and reporting.

The SAS Grid Manager Plug-in for SAS Environment Manager (referred to in this paper as the "plug-in" or "agent plug-in") is one of these agents. Its purpose is to periodically collect information about the SAS Grid. Previously, much of this same information was available through RTM.

SAS GRID MANAGER MODULE FOR SAS ENVIRONMENT MANAGER

HOME PAGE

The home page of the module can be accessed by logging in to SAS Environment Manager and clicking on the Administration tab. (See Figure 1.) This launches the SAS Environment Manager Administration module in a new browser window or tab. From the SAS Environment Manager Administration module (see Figure 2), click the menu icon in the top left corner to open the side menu. The side menu contains an entry for SAS Grid Manager. Click this entry to open the Home page of the SAS Grid Manager module.
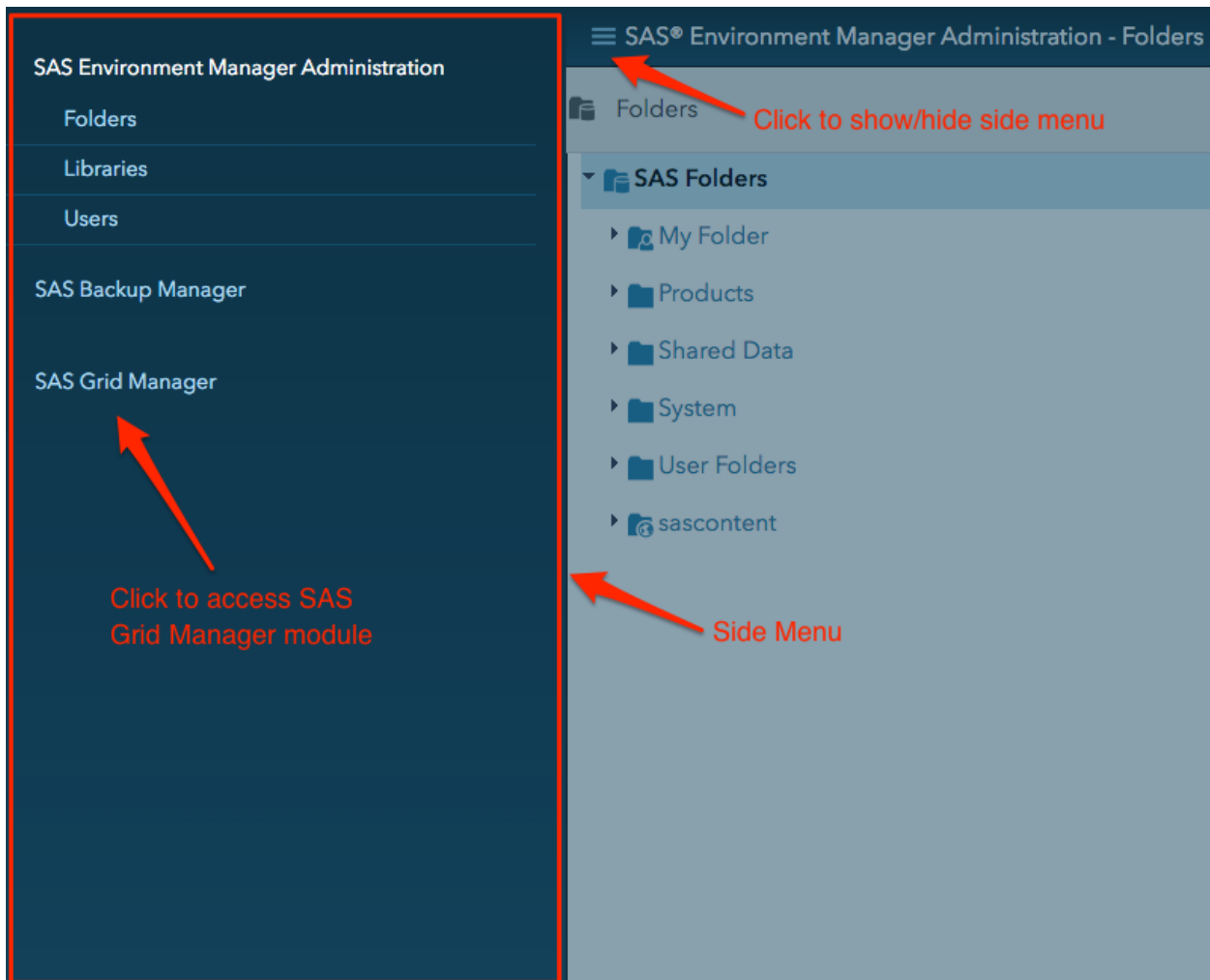
Figure 2: SAS Environment Manager Administration Module

The Home page (see Figure 3) contains a tile for each section of the application: Monitoring, LSF Configuration Manager, and HA Configuration Manager. These tiles serve as entry points to the various sections of the application. Clicking on a tile navigates to the corresponding section of the application.

The LSF Configuration Manager and HA Configuration Manager tiles each contain a number in the top right corner. These numbers represent the number of LSF and HA configurations, respectively, that are currently being managed. Note that when logging in to the application as a normal Grid user (in other words, a non-administrative user), the LSF Configuration Manager and HA Configuration Manager tiles are **not** available, since normal users do not have the necessary privileges to configure the SAS Grid.
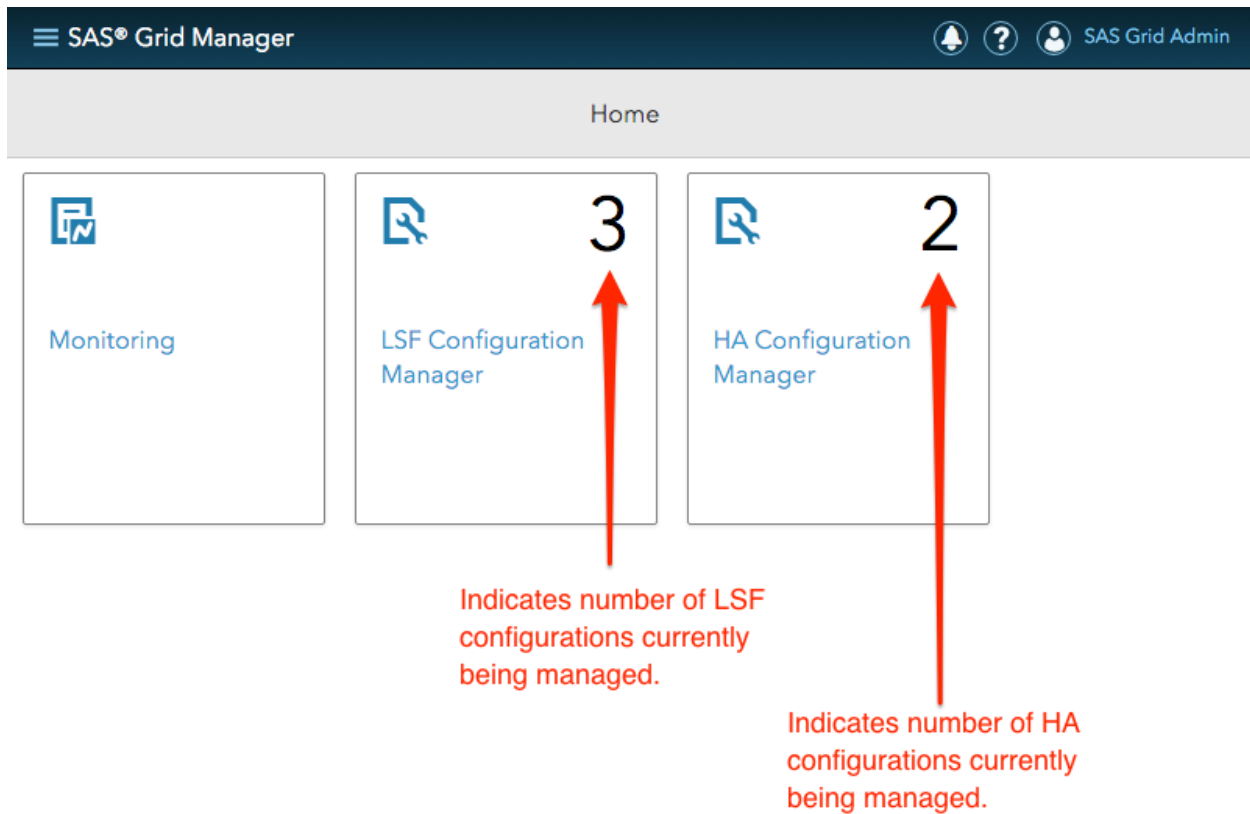
Figure 3: SAS Grid Manager Module Home Page

GETTING FAMILIAR WITH THE USER INTERFACE

The user interface of the SAS Grid Manager module contains navigation-related elements that are common throughout nearly all pages of the application. These include the Navigation Bar and the Title Bar. See Figure 4 for an example.
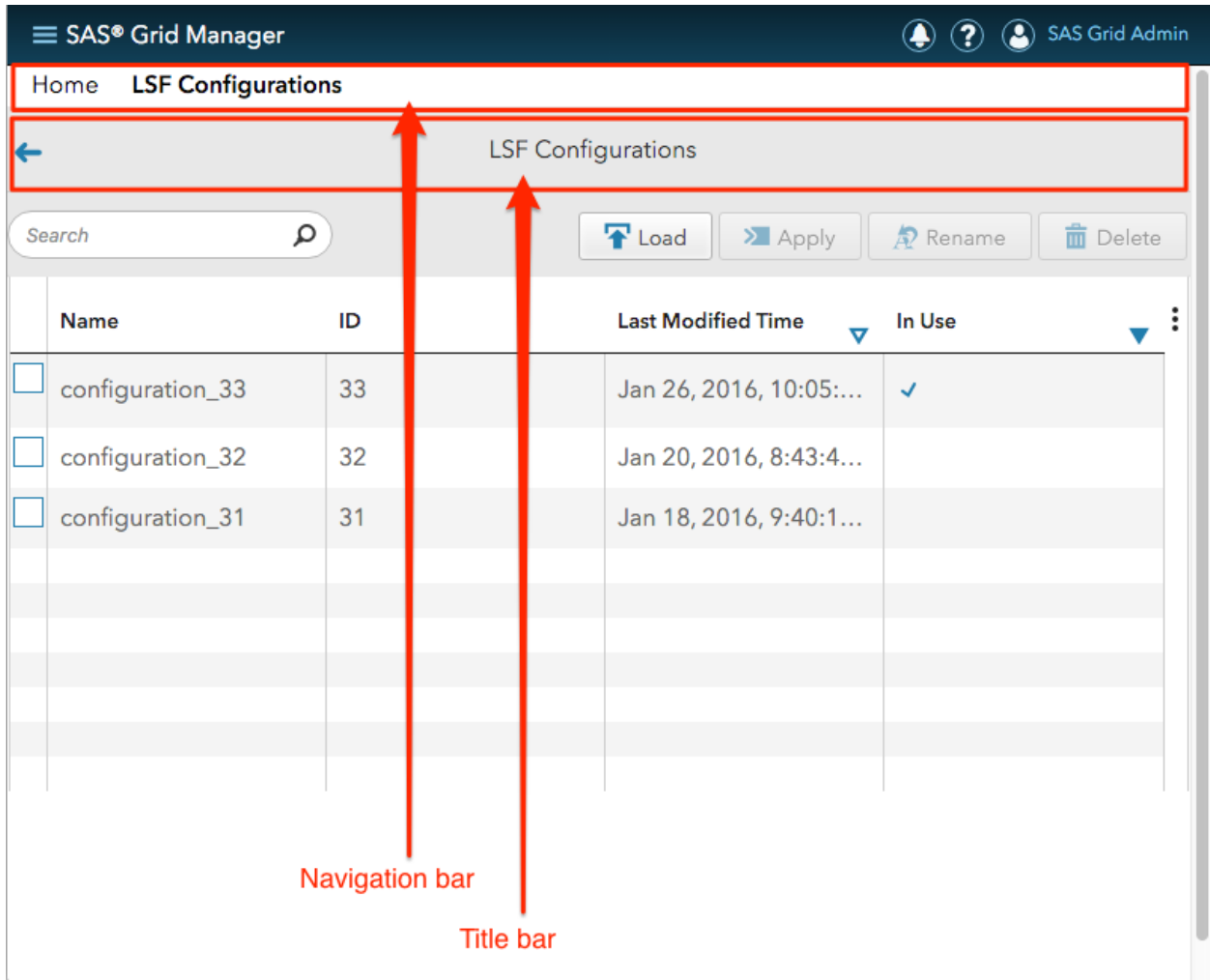
Figure 4: SAS Grid Manager Module Interface

Navigation Bar

The Navigation Bar is available on all pages of the module *except* for the Home Page. The Navigation Bar serves as a breadcrumb trail, which allows for direct navigation to previous pages within the current page hierarchy.

Title Bar

The Title Bar is available on all pages of the module. As the name implies, it contains the title of the current page. On all pages *except* for the Home Page, the title bar also contains a backward navigation button for jumping to the previously visited page.

CONFIGURATION

Configuration Summary Pages

To access configuration management, click on either the LSF Configuration Manager or HA Configuration Manager tile from the Home Page. Doing so will navigate to a page (see Figure 5) that contains a summary table of all managed configurations for LSF or HA, respectively.
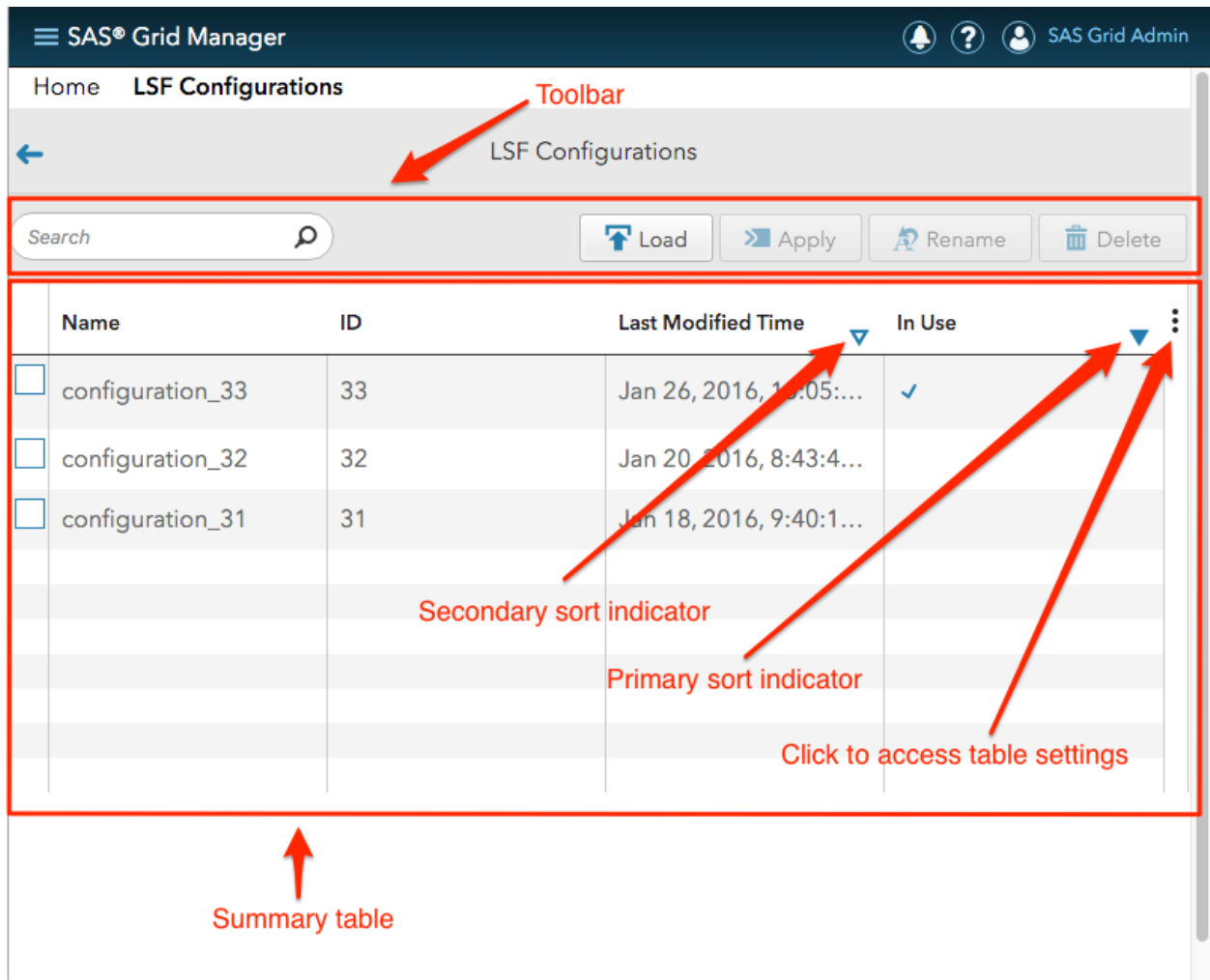
Figure 5: SAS Grid Manager Configuration Summary Page

The layout of these pages is identical for both LSF and HA configurations. The pages contain the following elements:

- Toolbar
- Summary table

Toolbar

The toolbar contains buttons for loading, applying, renaming, and deleting configurations, as well as a search field for quickly locating configurations within the table. Each of these functions are described in greater detail below.

Load

The Load button loads a new LSF configuration into the LSF Configuration Manager. There are several things worth noting about a newly loaded configuration:

- It represents the LSF configuration that is currently active on the SAS Grid. It is marked as "in use" by the presence of a check mark in the "In Use" column.
- The last modified time initially represents the time at which the configuration was loaded.
- The ID is auto-generated by a back-end service application (specifically, Platform Web Services). It uniquely identifies the configuration, and cannot be changed.

- The name has a default value of `configuration_<ID>` where `<ID>` is the auto-generated ID referenced above.

Apply

Applying an LSF configuration shuts down the SAS Grid, applies a new configuration, and restarts the SAS Grid. In order to apply a configuration, select a single configuration from the table by clicking the check box in the far-left column and then clicking the Apply button. After you click the button, a pop-up dialog box is displayed until the apply operation is complete. Note that if you don't select a configuration, or if you select more than one, the Apply button is disabled.

Rename

Often, administrators want to change the auto-generated configuration name. To rename a configuration, select the configuration of interest by clicking the check box in the far-left column and then clicking the Rename button. Note that if you don't select a configuration, or if you select more than one, the Rename button is disabled.

Delete

When a configuration is no longer needed, it can be deleted. To delete one or more configurations, select the configurations of interest by clicking the corresponding check boxes in the far-left column of the summary table and then clicking the Delete button. The configuration that is currently marked as "in use" *can* be deleted. Doing so does *not* impact the SAS Grid.

Search

The search bar allows you to quickly find a configuration by either name or ID. When you enter a value into the search bar, the summary table automatically filters to display only configurations for which the name or ID contains the entered value. Further, the filter is live-updated each time a new character is entered into the search bar. In other words, you don't need to enter a value and then click a "search" button. The table is updated automatically with each keystroke.

Summary Table

By default, the summary table contains the following columns:

- Name – The configuration name. This value can be changed by clicking the Rename button.

- ID – This is the unique identifier assigned to the configuration when it is initially loaded by the Load button. This value cannot be changed.

- Last Modified Time – A timestamp representing the last time the configuration was modified. If the configuration has never been modified, this value represents the time when the configuration was loaded.

- In Use – This column contains a checkmark for the configuration that is currently active on the SAS Grid. This column is blank for all other configurations. If, at any point, the configuration currently in use is deleted, the "In Use" column is blank for all configurations in the table.

By default, the summary table is sorted first on the "In Use" column and second on the "Last Modified Time" column. You can configure the table, including changing the visible columns and the column order, by clicking the ellipsis icon at the top right corner of the table.

LSF Configuration

LSF Configuration Entities

There are a number of different entity types that can be configured as part of an LSF configuration. The term "entity" is used in this paper to generically refer to the various resources that can be configured, such as cluster hosts, user groups, cluster administrators, and so on. Further, each entity type falls into one of three categories, based on how that particular entity type is configured. These categories have to do with whether you can define multiple, time-based configurations for a particular entity type. In this paper, these categories are referred to as follows:

- Non-time-based – Entities that only have a single configuration that does not change based on time of day or day of week.

- Time-based – Entities that can have multiple configurations. These entities will always have at least one configuration, known as the default configuration. They can also have additional configurations that take effect during certain time windows.

- Time-based attributes – Entities for which individual attributes within the configuration can have multiple values. For these entities, each attribute always has at least one value, known as the default value. Each attribute can also have additional values that take effect during certain time windows.

The following table provides additional information for each entity type:

Entity Type	Default summary table columns	Search by	Category
Cluster Host	Hostname, Model, Type, Server Type, Resources	Hostname	Non-time-based
Batch Host	Hostname, Maximum Job Slots	Hostname	Time-based
Host Group	Group Name, Group Members, Group Administrators, Condense	Group Name	Time-based
Queue	Queue Name, QJOB Limit, UJOB Limit, Priority, Nice, Rerunnable	Queue Name	Time-based attributes
Resource	Name, Type, Interval, Increasing, Consumable, Release, Description, Location	Name	Non-time-based
User	Username, Maximum Job Slots, Per-processor Job Slot Limit, Maximum Pending Jobs	Username	Time-based
User Group	Group Name, Group Members, User Shares, Group Administrators	Group Name	Time-based
Resource Limit	Name, Users, Queues, Hosts, Slots	Name	Time-based attributes
Cluster Administrator	Username	Username	Non-time-based
Cluster Parameter	Name, Value	Name, Value	Varies. Time-based attributes for batch parameters. Non-time-based for all others.

Table 1: LSF Configuration Entity Types

LSF Configuration Page

The LSF Configuration page (see Figure 6) is accessed by clicking a configuration in the summary table on the LSF Configuration Summary Page.
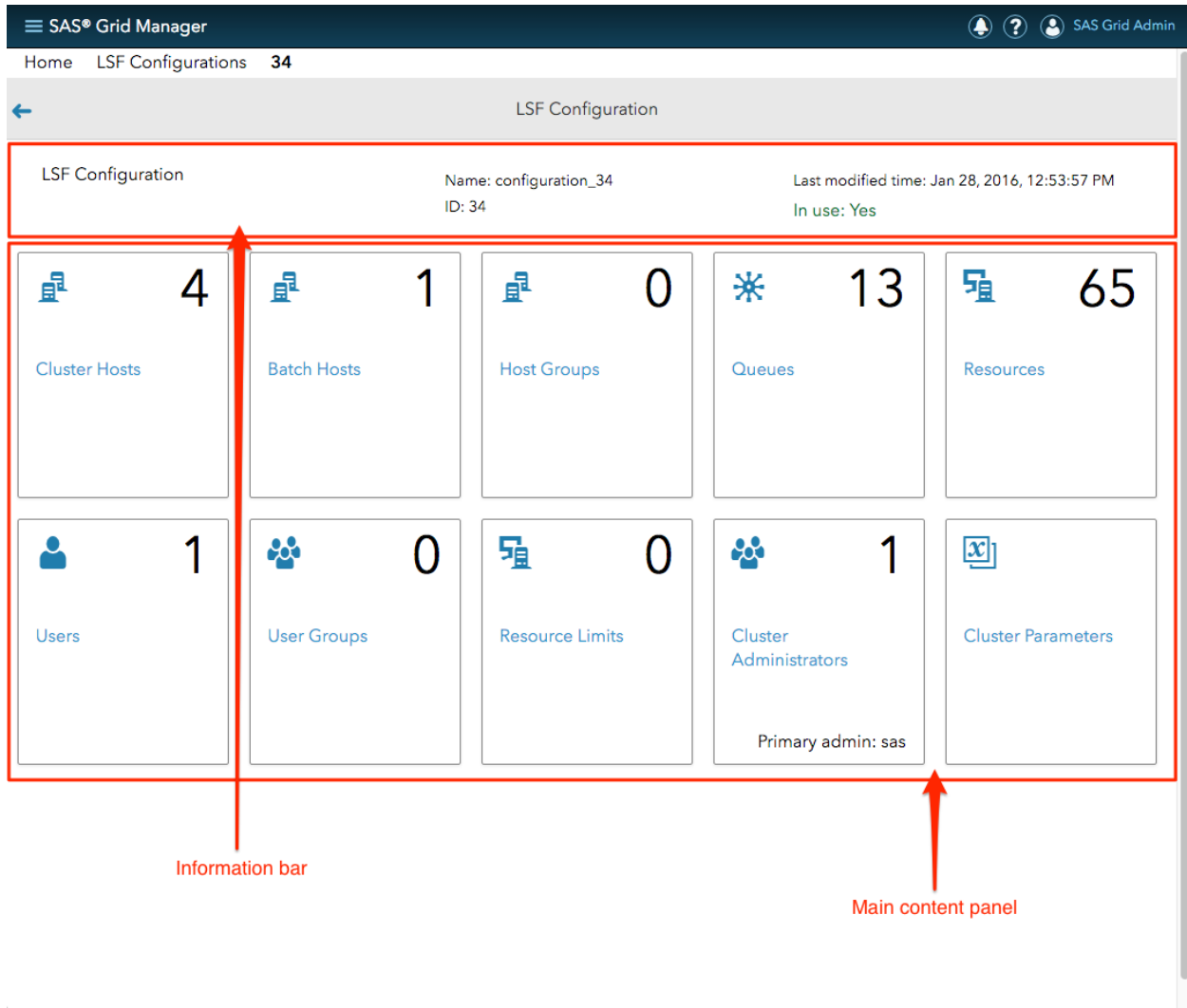
Figure 6: LSF Configuration Page

The LSF Configuration page contains the following elements:

- Information bar
- Main content panel

The information bar displays the name and ID of the current configuration, the time it was last modified, and whether the configuration is in use. This information bar remains visible on all sub-pages of the LSF Configuration page so that the user can tell at a glance which configuration is currently being viewed or edited.

The main content panel of the LSF Configuration page contains the following tiles, each of which represents a specific entity type described in Table 1:

- Cluster Hosts
- Batch Hosts
- Host Groups
- Queues
- Resources

- Users

- User Groups

- Resource Limits

- Cluster Administrators

- Cluster Parameters

Note that, with the exception of the Cluster Parameters tile, all tiles contain a number in the top right corner. This number represents the number of entities currently defined for that tile.

LSF Configuration Entity Summary Page

Clicking on any tile on the LSF Configuration Page navigates to the summary page for that tile's respective entity type. The entity summary pages have the following layout:

- Toolbar

- Information bar

- Summary table

See Figure 7 for an example, using the Cluster Hosts Summary page.

The toolbar contains a search field for quickly finding an entity in the table, as well as buttons for adding and deleting entities. Note that the Cluster Parameters summary page (see Figure 8) is different. Rather than containing Add and Delete buttons, the toolbar on this page contains an Edit button. When you click this button, a form page appears for adding, editing, and deleting cluster parameters.

The summary table contains the same information that was available in Platform RTM for each entity type. See Table 1 for a listing of which columns are available by default for each entity type. By default, these tables are sorted in ascending order by the entity name. With the exception of the Cluster Administrators and Cluster Parameters summary tables, the rows of the entity summary tables are clickable. When a row is clicked, the application navigates to a form page that enables you to configure the entity.

Figure 7: LSF Configuration Entity Summary Page (using Cluster Host Summary Page as an example)

Figure 8: LSF Cluster Parameters Summary Page

LSF Configuration Entity Form Pages

The form pages used to configure LSF entities contain the following elements:

- Toolbar
- Information bar
- Form content

The toolbar contains Save and Cancel buttons.

The layout of the form content varies, depending on the category of the entity type you are editing. (See Table 1.)

For non-time-based entities, the form page (see Figure 9 and Figure 10) contains two vertically stacked panels. The top panel is for basic settings. Basic settings are those settings that were supported directly in Platform RTM. The bottom panel, which is hidden by default, is for advanced settings, and it contains

settings that were *not* supported directly in Platform RTM. To access the advanced settings, click the "Show advanced settings" link below the basic settings form panel. The advanced settings form contains an Advanced section where you can add additional attributes that were not supported when the SAS Grid Manager module was initially released.
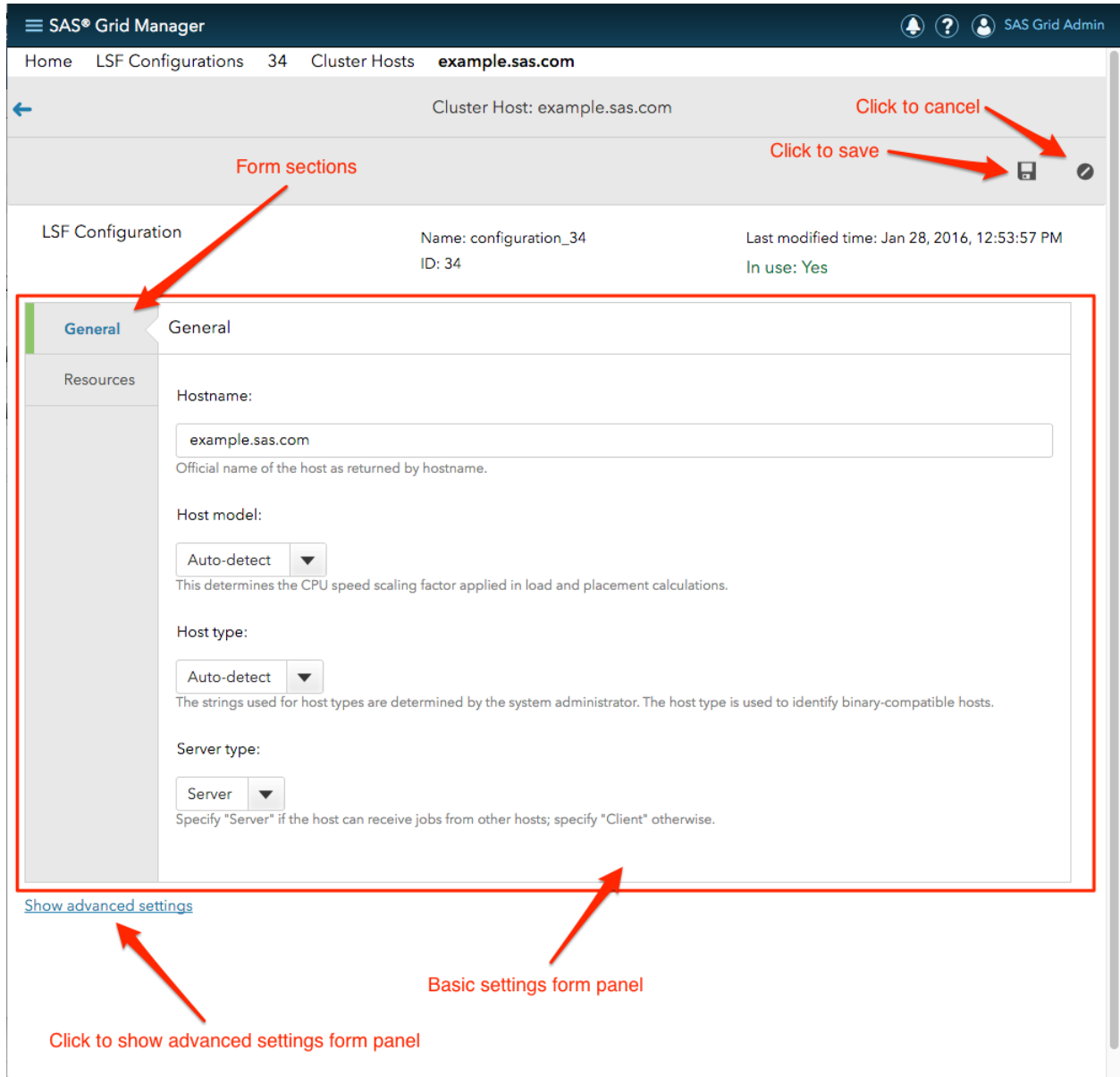
Figure 9: Basic Settings Form Panel for a Non-Time-Based Entity (using cluster host as an example)
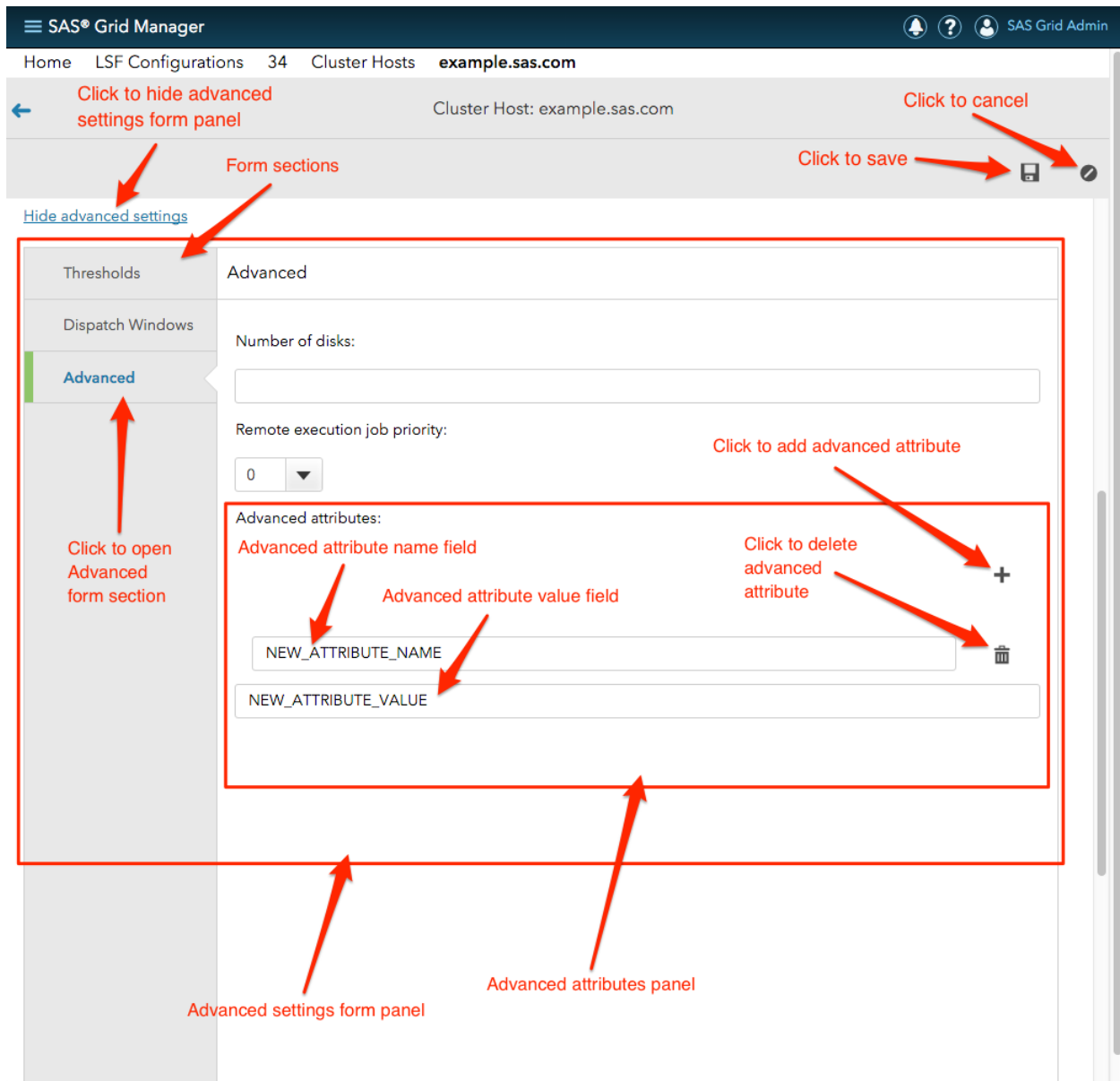
Figure 10: Advanced Settings Form Panel for a Non-Time-Based Entity (using cluster host as an example)

For time-based entities, the form page (see Figure 11) contains two vertically stacked panels. The top panel contains a form for configuring the entity name. The bottom panel contains a form for each defined configuration of the entity. This bottom panel has a panel header with the title "Time-Based Configurations," and contains a clock icon for adding time-based configurations. If multiple configurations exist, controls also appear to the left of the clock icon to expand or collapse all configuration forms simultaneously. If there is only a single configuration (the default configuration), the expand/collapse all controls are not visible, and the default configuration form is not expandable or collapsible.

A time-based entity always has at least one configuration, referred to as the default configuration. Additional configurations can be added by clicking the clock icon. When more than one configuration exists, each configuration is contained within a collapsible panel. Each collapsible panel has a header containing an expand/collapse icon, a title indicating the time window for which the configuration will be in effect, and a Delete button (for deleting the configuration). Because the default configuration *cannot* be deleted, the panel header for the default configuration does not have a delete button. Also, for all

configurations *except* for the default, the title itself can be clicked to configure the start and end time for the time window.

Each configuration form panel contains two sub-panels. The first sub-panel contains a form for basic settings, which are the same settings supported directly in Platform RTM. The second sub-panel contains a form for advanced settings. This panel is hidden by default, but can be accessed by clicking the "Show advanced settings" link below the basic settings form panel. This form contains settings that are supported by SAS Grid Manager, but which were not supported directly in Platform RTM. The advanced settings form also contains an Advanced section where you can specify additional attributes that were not supported when the SAS Grid Manager module was initially released.
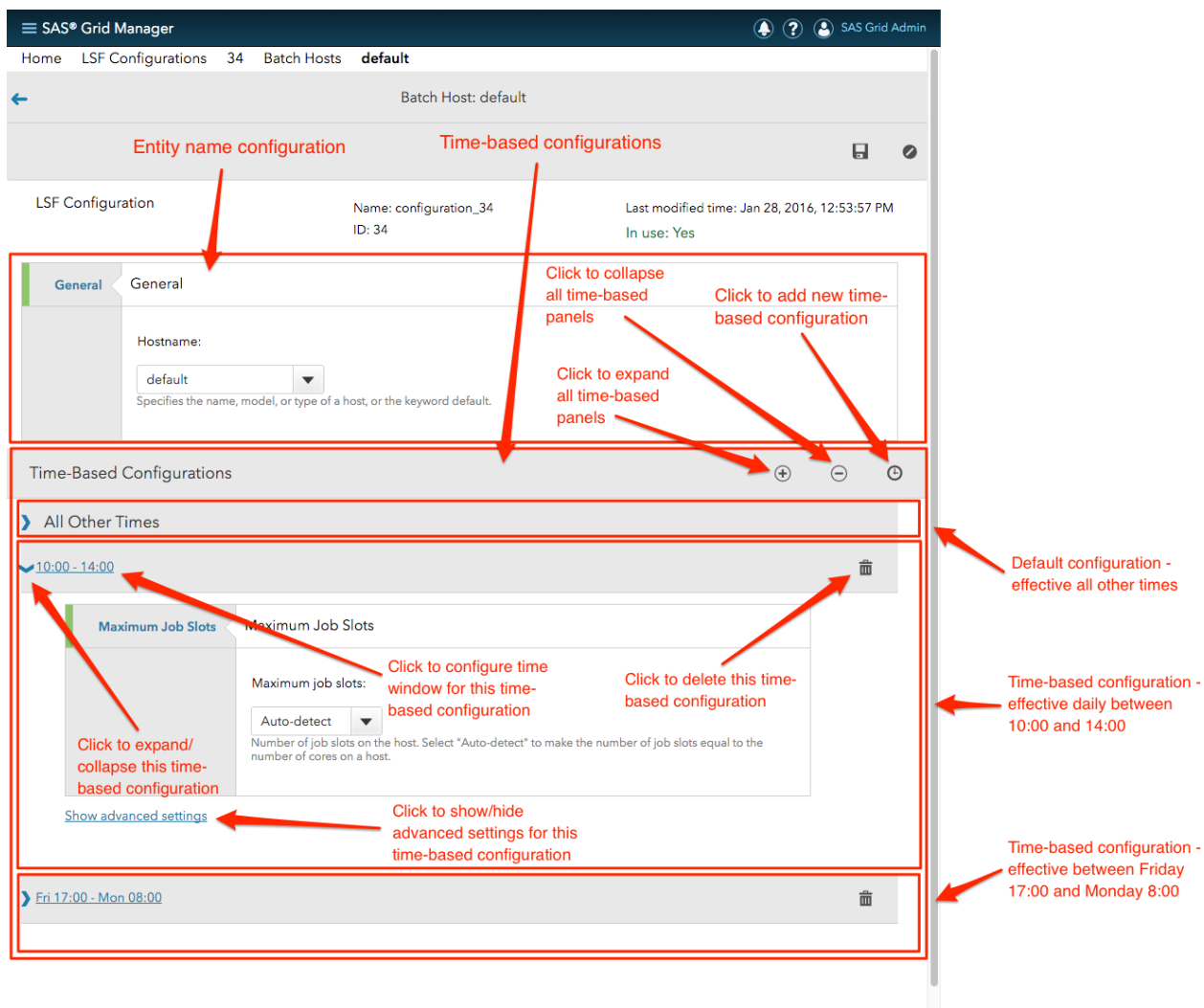
Figure 11: Form Page for a Time-Based Entity (using batch host as an example)

For time-based attribute entities, the form page has the same basic layout as that of non-time-based entities. The difference is that, with the exception of the entity name, individual attributes can have multiple time-based values. Each attribute always has at least one value, which is referred to as the default value. Additional values can be added by clicking the clock icon, located just below and to the right of the attribute field label. When more than one value exists for an attribute, each value is nested within a collapsible panel. Each collapsible panel has a header containing an expand/collapse icon, a title indicating the time window for which the value will be in effect, and a Delete button (for deleting the value). Because the default value cannot be deleted, the panel header for the default value does *not* have a delete button. Also, for all values *except* for the default, the title itself can be clicked to configure the start and end time for the time window. When multiple attribute values exist, expand/collapse all controls

appear to the left of the clock icon. These buttons are used to expand or collapse all attribute value panels simultaneously.
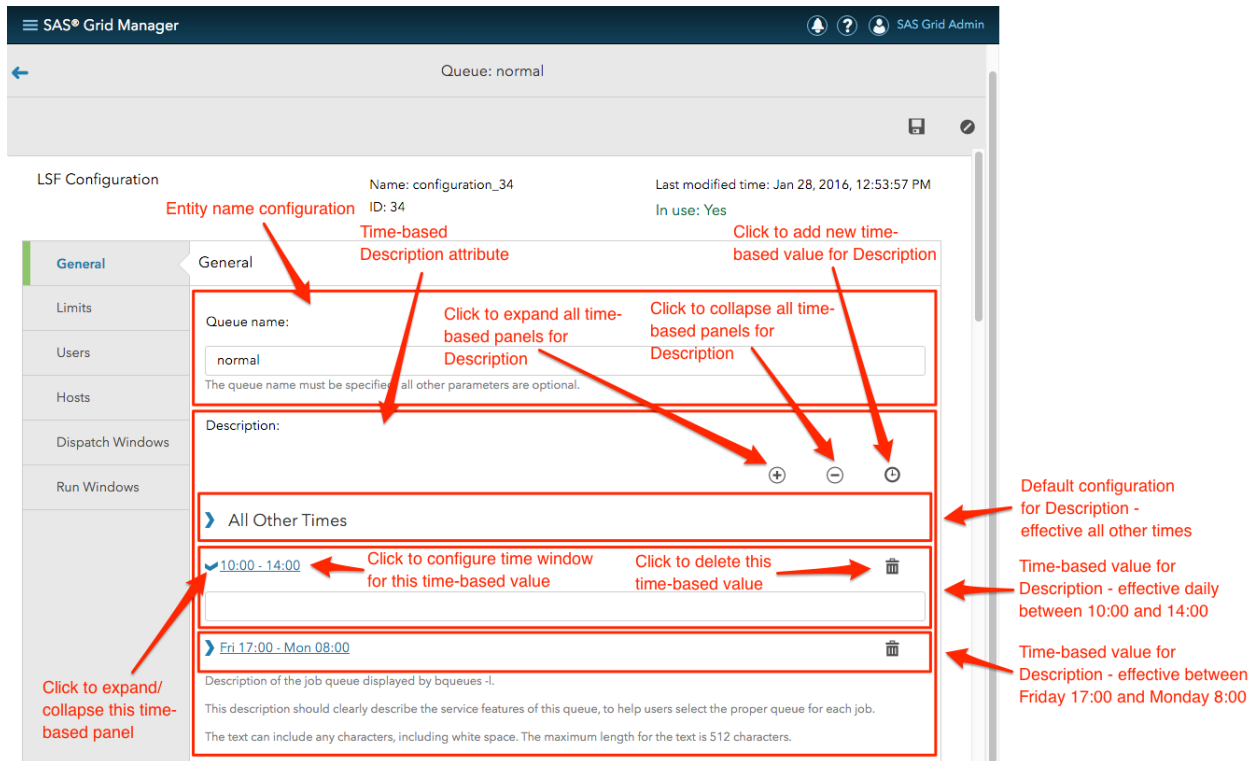
Figure 12: Form Page for a Time-Based Attribute Entity (using queue as an example)

There is not a form page for adding cluster administrators. Instead, from the Cluster Administrators page (see Figure 15), click the Add button in the toolbar. A pop-up dialog box (see Figure 16) is displayed, which contains an input field for the cluster administrator user name. Enter the user name into this field and click Save. Note that if you enter the user name of an existing administrator (including the primary administrator), the Save button is disabled to prevent the same user name from being added multiple times.

The Cluster Parameters form page has the same basic layout as that of non-time-based entities. The top panel (see Figure 13) contains basic settings, which are the same settings that were supported in Platform RTM. The bottom panel (see Figure 14) contains advanced settings, which are settings that were not supported directly in Platform RTM.

Figure 13: Edit Cluster Parameters Form Page – Basic Settings
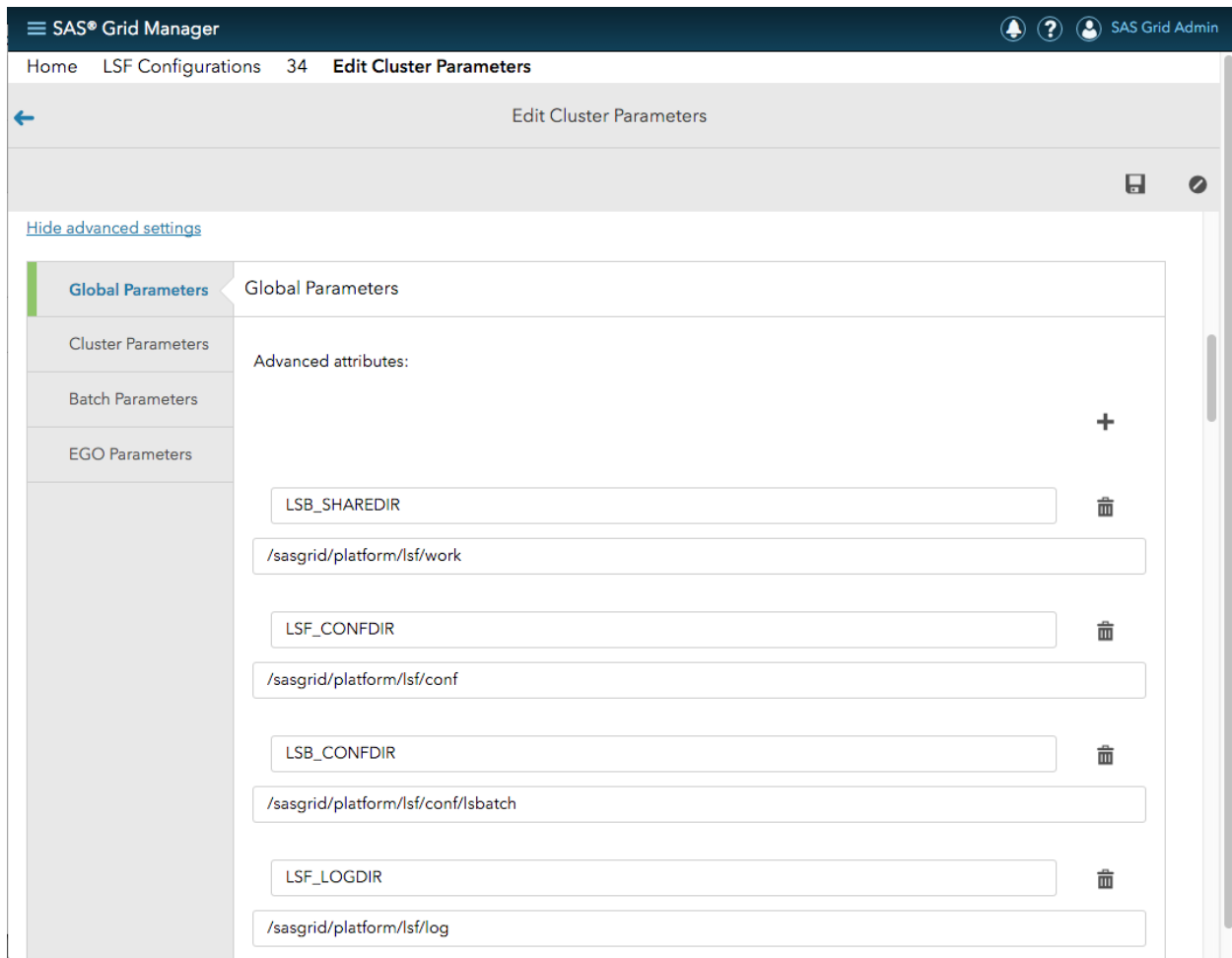
Figure 14: Edit Cluster Parameters Form Page – Advanced Settings

Table 2 lists the various form sections found on the Edit Cluster Parameters form page, a description for each section, and the corresponding LSF text-based configuration file where the settings found in a given form section are found:

Form Section Name	Description	LSF configuration file in which settings are found
Global Parameters	Settings that control the operation of LSF.	$LSF_ENVDIR/lsf.conf
Master Hosts	List of hosts that are candidates to become the master host for the cluster.	$LSF_ENVDIR/lsf.conf
Server Hosts	List of server hosts that a client should contact to find a Load Information Manager (LIM).	$LSF_ENVDIR/lsf.conf
User Domains	List of Windows domains. Enables the UNIX/Windows user account mapping feature, which allows cross-platform job submission and execution in a mixed UNIX/Windows environment.	$LSF_ENVDIR/lsf.conf

Cluster Parameters	Settings that relate to the LSF cluster.	$LSF_ENVDIR/lsf.cluster.***CLUSTER_NAME***
Batch Parameters	Batch-related settings used by LSF.	$LSF_ENVDIR/lsbatch***CLUSTER_NAME***/configdir/lsb.params
EGO Parameters	Settings used by Enterprise Grid Orchestrator (EGO)	$LSF_ENVDIR/ego***/CLUSTER_NAME***/kernel/ego.conf

Table 2: Cluster Parameters Form Sections

Table 3 lists the required fields for each of the LSF entity types. If any of these fields are left blank, you cannot save the configuration.

Entity	Required Form Fields
Cluster Host	Hostname
Batch Host	Hostname
Host Group	Group name
Queue	Queue name
Resource	Name
User	Username, Maximum jobs, Job slot limit, Maximum pending jobs
User Group	Group Name
Resource Limit	Resource limit name

Table 3: Required Fields for LSF Entity Form Pages

Note that there is *not* a form page for cluster administrators. Instead, a pop-up dialog box is displayed when you click the Add button from the Cluster Administrators summary table page. See Figure 15 and Figure 16 for more information.

Figure 15: LSF Cluster Administrators

Figure 16: Add LSF Cluster Administrator Dialog Box

HA Configuration

The SAS Grid Manager Module for SAS Environment Manager can be used to manage high-availability applications. A set of applications collectively make up an HA configuration. The SAS Grid Manager Module for SAS Environment Manager can manage multiple HA configurations.

High-Availability Applications Summary Page

The HA Configurations summary page (see Figure 17) has already been discussed in the previous section titled Configuration Summary Pages. From the HA Configurations summary page, a particular configuration can be modified by clicking on a row in the table to access the High-Availability Applications summary page (see Figure 18) for the configuration.

Figure 17: HA Configurations Summary Page

Figure 18: High-Availability Applications Summary Page

HA Application Form Page

This page is used to configure an HA application. The layout of the form on this page is modeled after Platform RTM. Specifically, the form has the following four sections:

- General – For configuring the application name, version, and description. See Figure 19.

- HA Settings – For configuring an application as either Active-Passive or Active-Active, and for configuring other failover-related settings. See Figure 20 and Figure 21.

- Execution Settings – For configuring settings related to running an application such as the start and stop commands, execution user, and start-up type. See Figure 22.

- Dependencies – For listing other HA applications on which this application depends. See Figure 23.

In order to define a new HA application, the following fields are required:

- Application name, found in the General form section. (See Figure 19.)

- Start command, found in the Execution Settings form section. (See Figure 22.)

- Execution user, found in the Execution Settings form section. (See Figure 22.)

Once all of the required fields have been filled out, as well as any desired optional fields, click the Save button in the toolbar to save the application.

Figure 19: HA Application – General Settings

Figure 20: HA Application – HA Settings – Active-Passive

Figure 21: HA Application – HA Settings – Active-Active

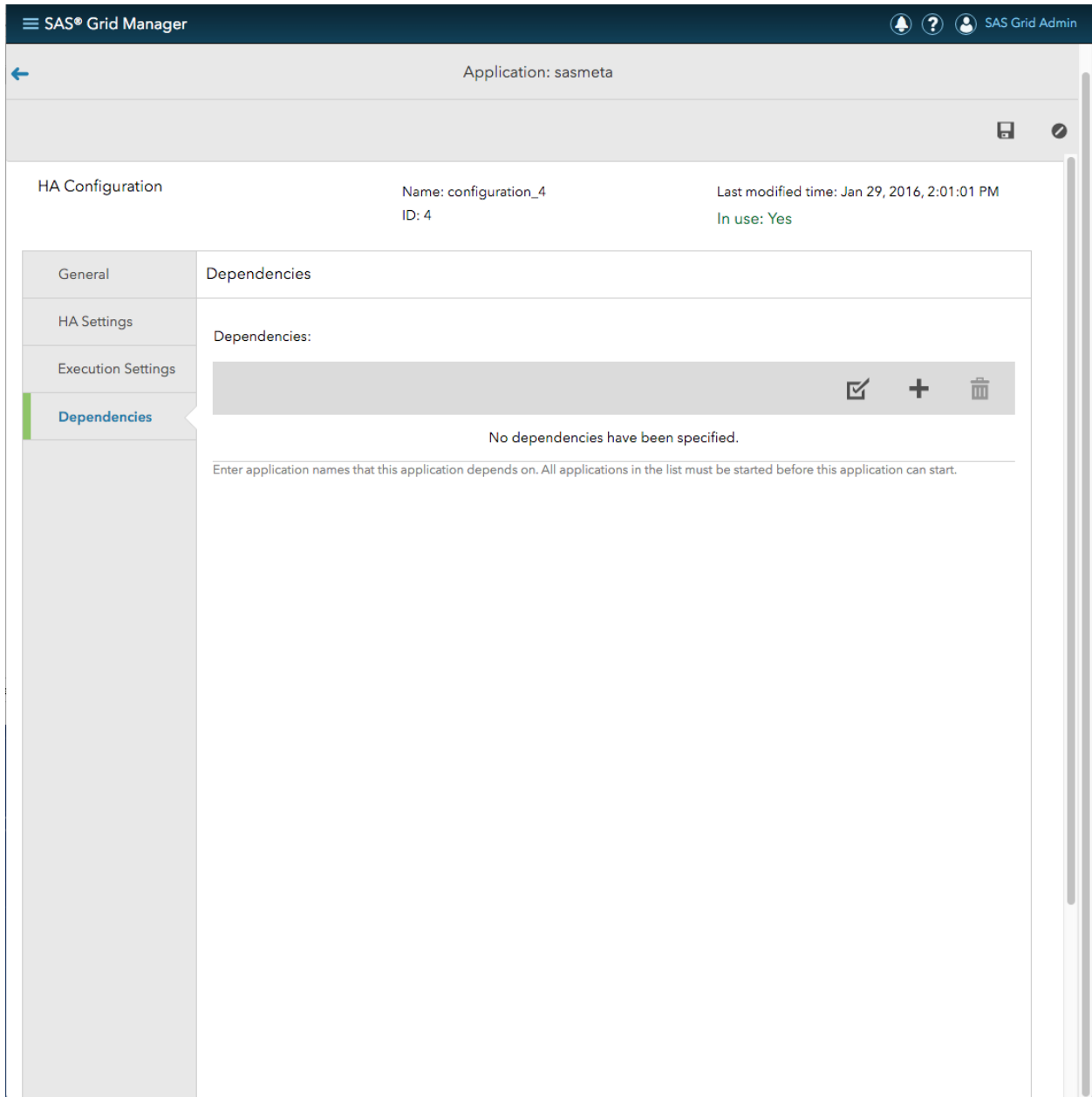**Figure 22: HA Application – Execution Settings**

Figure 23: HA Application - Dependencies

MONITORING

The SAS Grid Manager Module for SAS Environment Manager provides comprehensive monitoring information about the grid cluster, jobs, queues, hosts, high availability applications, and audit logs through the Monitoring tile. The Monitoring section of the module is a full replacement for the SAS Grid Manager plug-in for SAS Management Console, and it provides much of the same information previously available through Platform RTM.

In order to access the Monitoring summary page (see Figure 24), click the Monitoring tile from the Home Page.
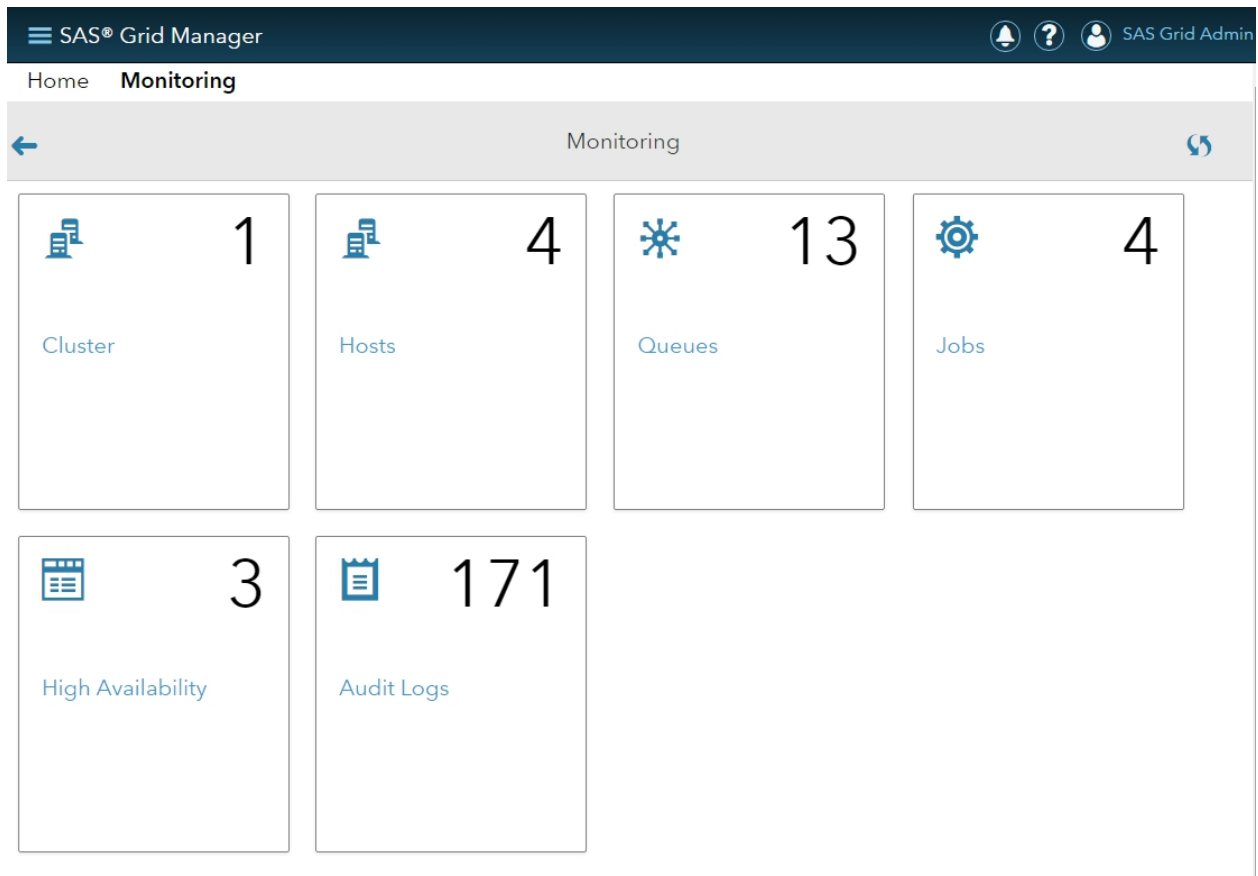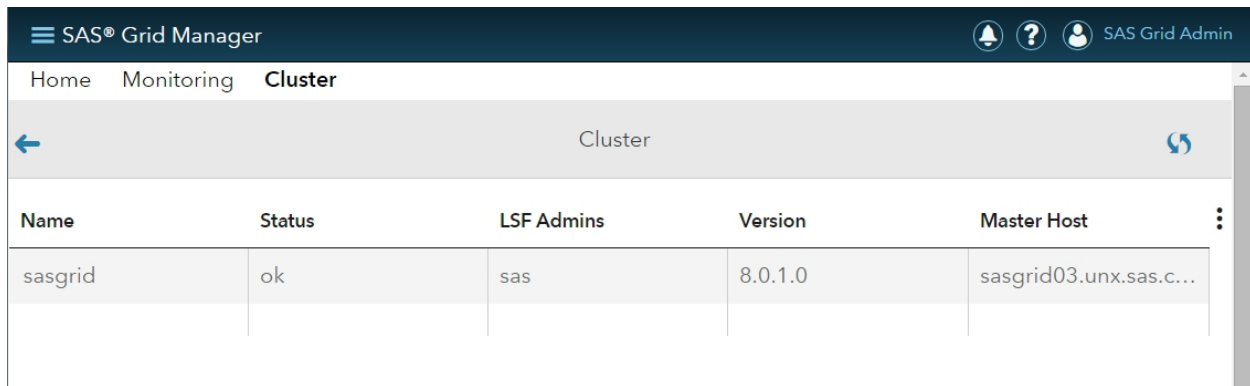
Figure 24: Monitoring Summary Page

The number in the upper right corner of each tile represents the total number of items found within that tile. Note that when logging in to the application as a normal Grid user (a non-administrative user), the High Availability and Audit Logs tiles are not available.

All pages within the monitoring section of the module contain quick search, refresh, sorting, as well as table configuration features.

Cluster Information

To access the Cluster monitoring page (see Figure 25), click the Cluster tile from the Monitoring Summary Page. This page contains summary information about the cluster including name, status, LSF administrators, version, and LSF master host.

Figure 25: Cluster Monitoring Page

Host Summary Information

The Host monitoring page lists the host name, status, type, model, maximum job slots, and total jobs for each host on the grid.

Figure 26: Host Monitoring Summary Page

Host Detail Information

To access detailed information for a particular host, click the corresponding table row for that host on the Host Monitoring Summary Page. The Host monitoring detail page (see Figure 27) uses a tabbed layout and contains the following tabs:

- Information – Information about the host such as job slots per user, number of jobs that were suspended by the user, and the number of running jobs.

- Resource – Information about the resources available on the host such as number of CPUs, maximum memory, and number of disks.

- Load - Information about various measures of load on the host such as 15-second load over the last 15 seconds, I/O actions, and memory used.

Figure 27: Host Monitoring Detail Page

Job Summary Information

The Job monitoring summary page contains summary information for the jobs that have been submitted to the grid. If you are logged in to the module as an LSF Administrator, information for all jobs will be displayed. If logged in to the module as a non-administrative user, only information for the current user's jobs will be displayed.

Figure 28: Job Monitoring Summary Page

Job Detail Information

To access detailed information for a particular job, click the corresponding table row for that job on the Job Monitoring Summary Page. The Job monitoring detail page (see Figure 29) uses a tabbed layout and contains the following tabs:

- Job Information - Information about the job, including execution host, queue name, command, start time, and end time.

- Job History - Information about the execution history of the job, including summaries of the job information, time information (such as run time, pending time, and suspended time), and the job contents (such as event logs showing submission time, start time, end time, error messages, and so on).

Figure 29: Job Monitoring Detail Page

Queue Summary Information

The Queue monitoring summary page (see Figure 30) lists the queue name, status, priority, maximum job slots, and total jobs for each queue.

Figure 30: Queue Monitoring Summary Page

Queue Detail Information

To access detailed information for a queue, click on that queue in the table on the Queue Monitoring Summary Page to navigate to the Queue monitoring detail page. (See Figure 31.) The Queue monitoring detail page uses a tabbed layout and contains the following tabs:

- Information - Detailed information about the queue, such as priority, number of pending jobs, and the hosts used by the queue.

- Load - Information about various measures of load on the queue, including a 15-second load over the last 15 seconds, I/O actions, and memory used.

- Attributes - Optional attributes defined for the queue.

Figure 31: Queue Monitoring Detail Page

High Availability Application Information

High availability applications are configured through the Note that there is *not* a form page for cluster administrators. Instead, a pop-up dialog box is displayed when you click the Add button from the Cluster Administrators summary table page. See Figure 15 and Figure 16 for more information.
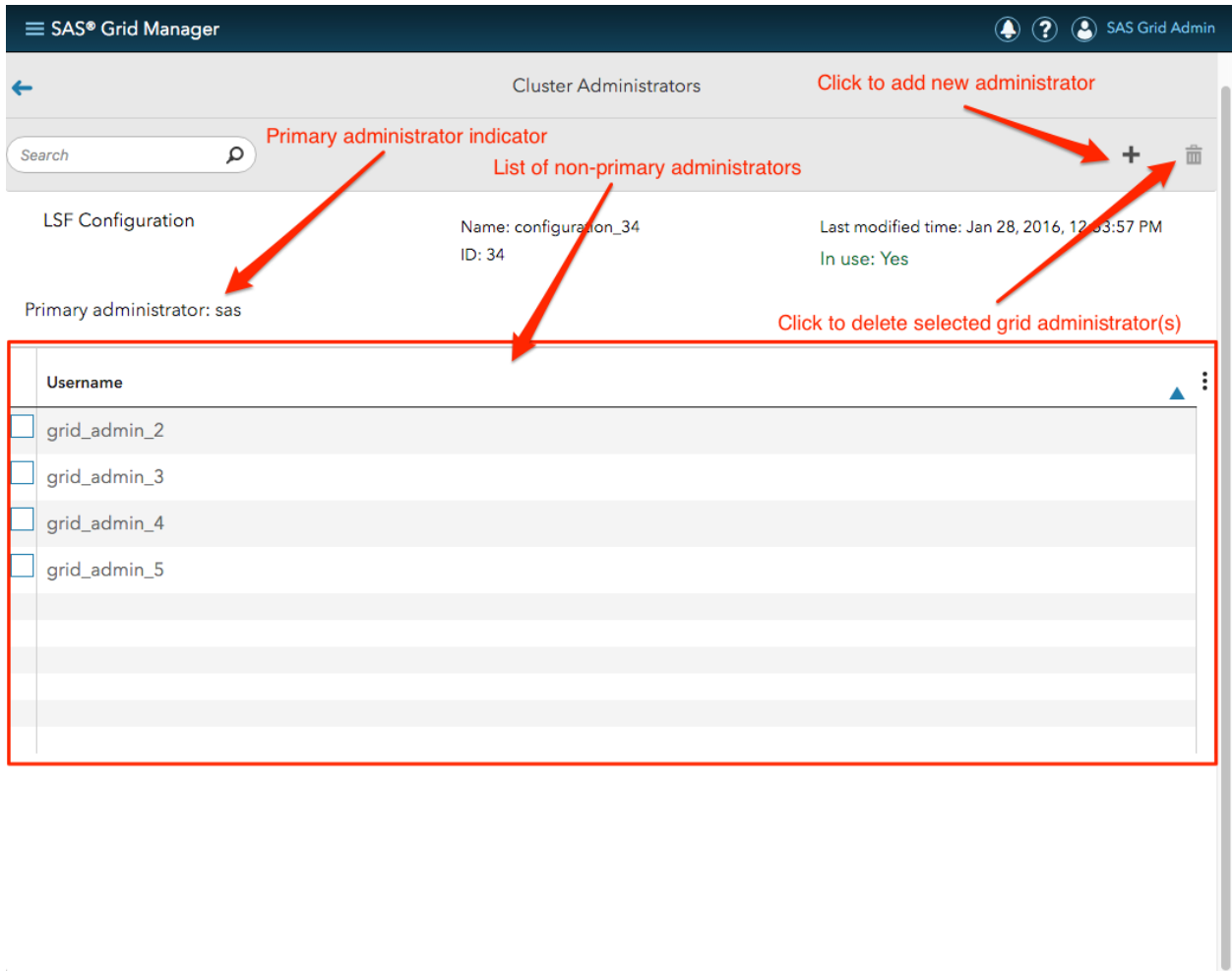
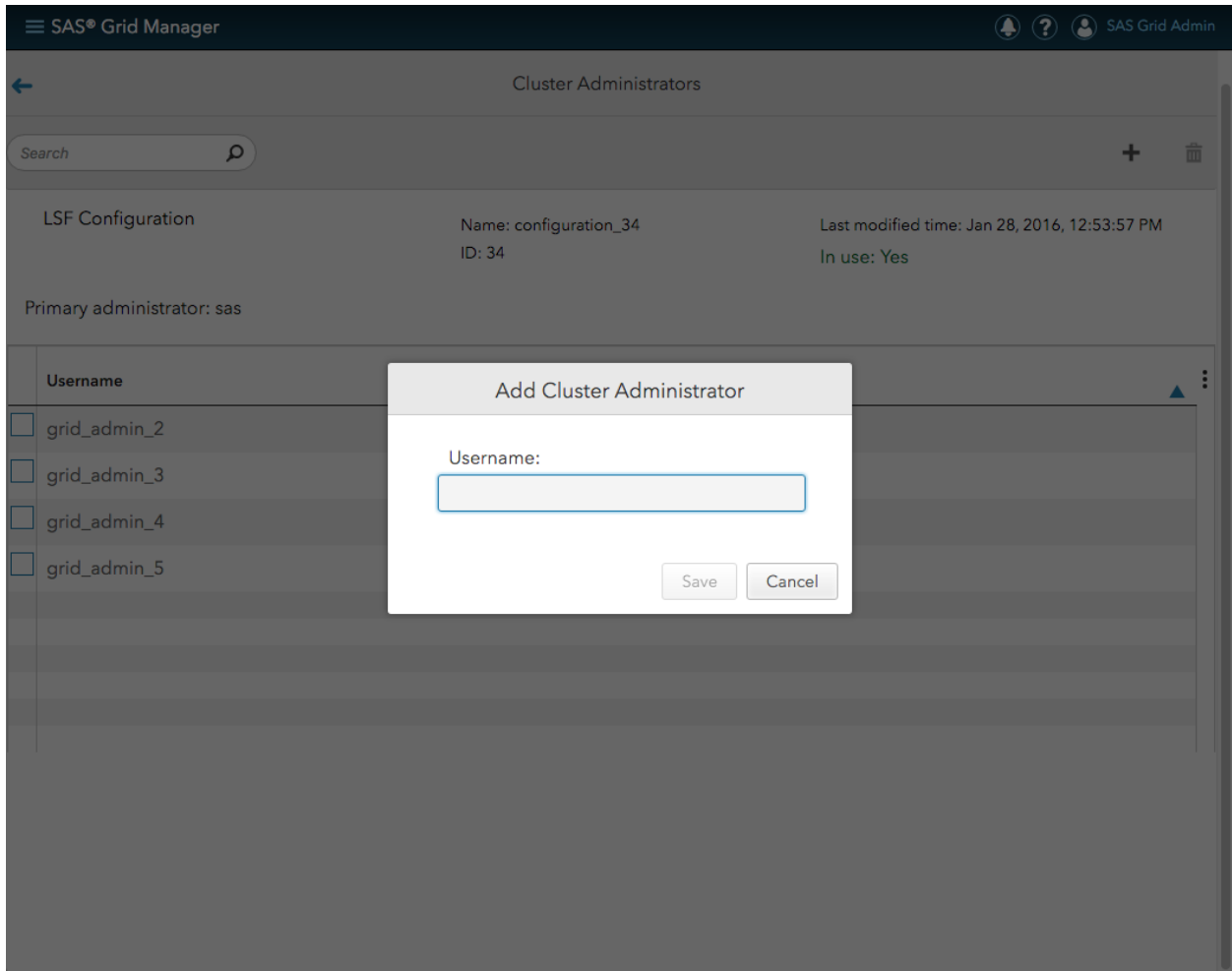**Figure 15: LSF Cluster Administrators**

Figure 16: Add LSF Cluster Administrator Dialog Box

HA Configuration section of the SAS Grid Manager Module for SAS Environment Manager. The High Availability application monitoring page (see Figure 32) enables you to view information about high availability applications.

Figure 32: High Availability Application Monitoring Page

Audit Log Summary Information

The Audit Log summary page (see Figure 33) displays all of the transaction records for Platform Web Services.

Figure 33: Audit Logs Summary Page

Table 1 shows the various actions types that are captured in the audit logs.

Entity Type	Action	Action Type
Hosts	open, close	HOST
Queues	open, close, activate and inactivate	QUEUE
Jobs	Resume, suspend, and terminate	JOB
HA Applications	Migrate, restart, start, and stop	HA
LSF Configuration	Delete, save, apply, and load	LSF_CONFIGURE
HA Configuration	Delete, save, apply, and load	HA_CONFIGURE

Table 4: Audit Log Action Types

Audit Log Detail Information

To get detailed information for an audit log record, click on that record in the table to navigate to the Audit Log detail page. (See Figure 34.)

Figure 34: Audit Log Detail Page

MANAGEMENT

The SAS Grid Manager Module for SAS Environment Manager provides comprehensive functionality for managing grid jobs, queues, hosts, and high availability applications through the Monitoring tile. If you are logged in to the module as a non-administrative user, only jobs belonging to the current user can be managed. Non-administrative users do not have permission to manage hosts, queues, and high availability applications.

Administrative users can perform the following operations:

- Open and close hosts.

- Open, close, activate and inactivate queues.

- Resume, suspend, and terminate jobs.

- Migrate, restart, start, and stop high availability applications.

All of the above-listed actions can be performed against a single object or against multiple objects simultaneously. In order to perform actions against one or more objects, click the check box, in the far left-hand column of the table, for each object. All objects visible on the current page can be simultaneously selected or deselected by clicking the column heading of the check box column. Once the objects of interest are selected, the drop-down list found on the far right of the toolbar above the table displays the actions that can be taken on the selected objects. Once the desired action is selected, a

confirmation dialog box is displayed. Click the Yes button to confirm or the No button to cancel. If the action is confirmed, a message dialog box appears to indicate whether the action was performed successfully. Figure 35 and Figure 36 show an example of the action confirmation dialog box and the action successful dialog box (using selection and inactivation of two queues as an example), respectively.
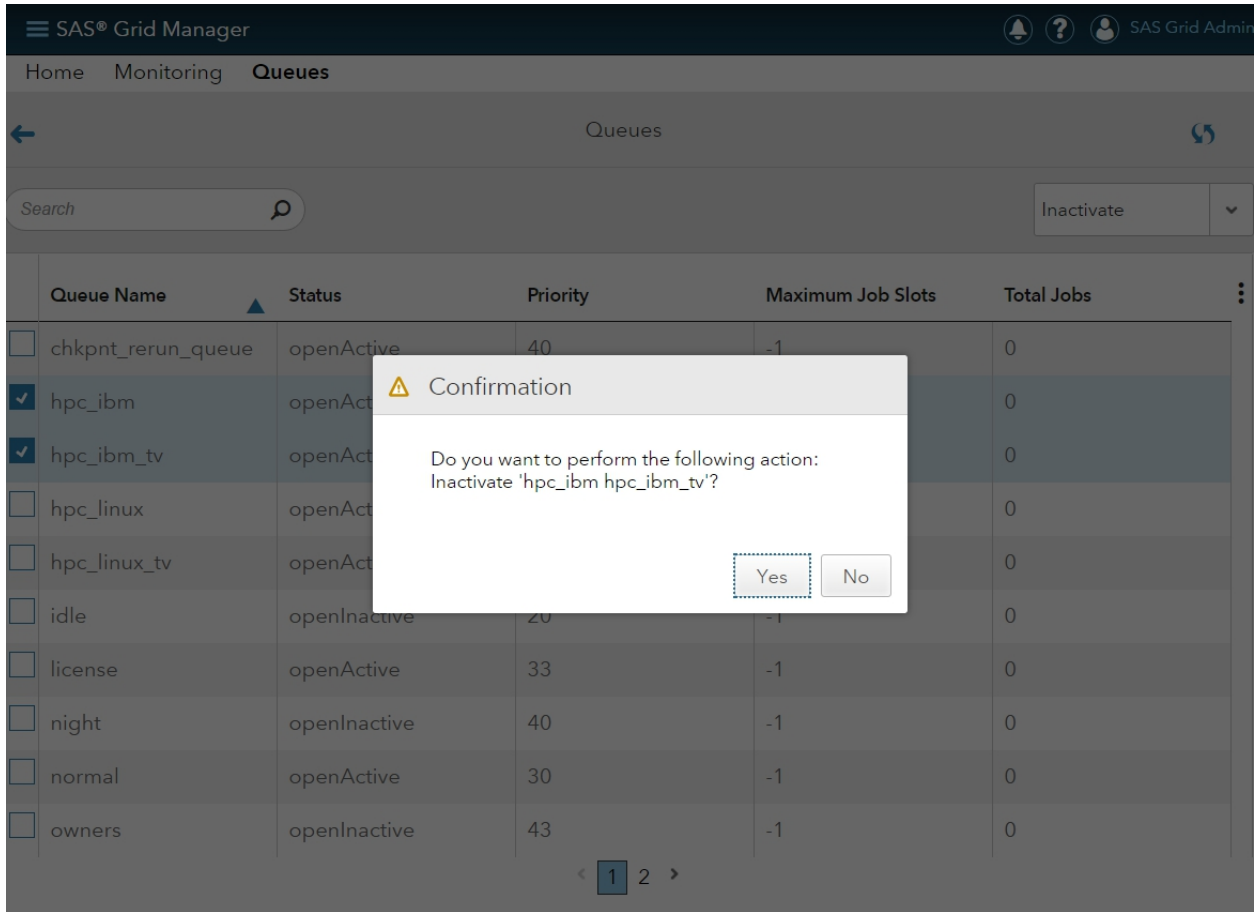

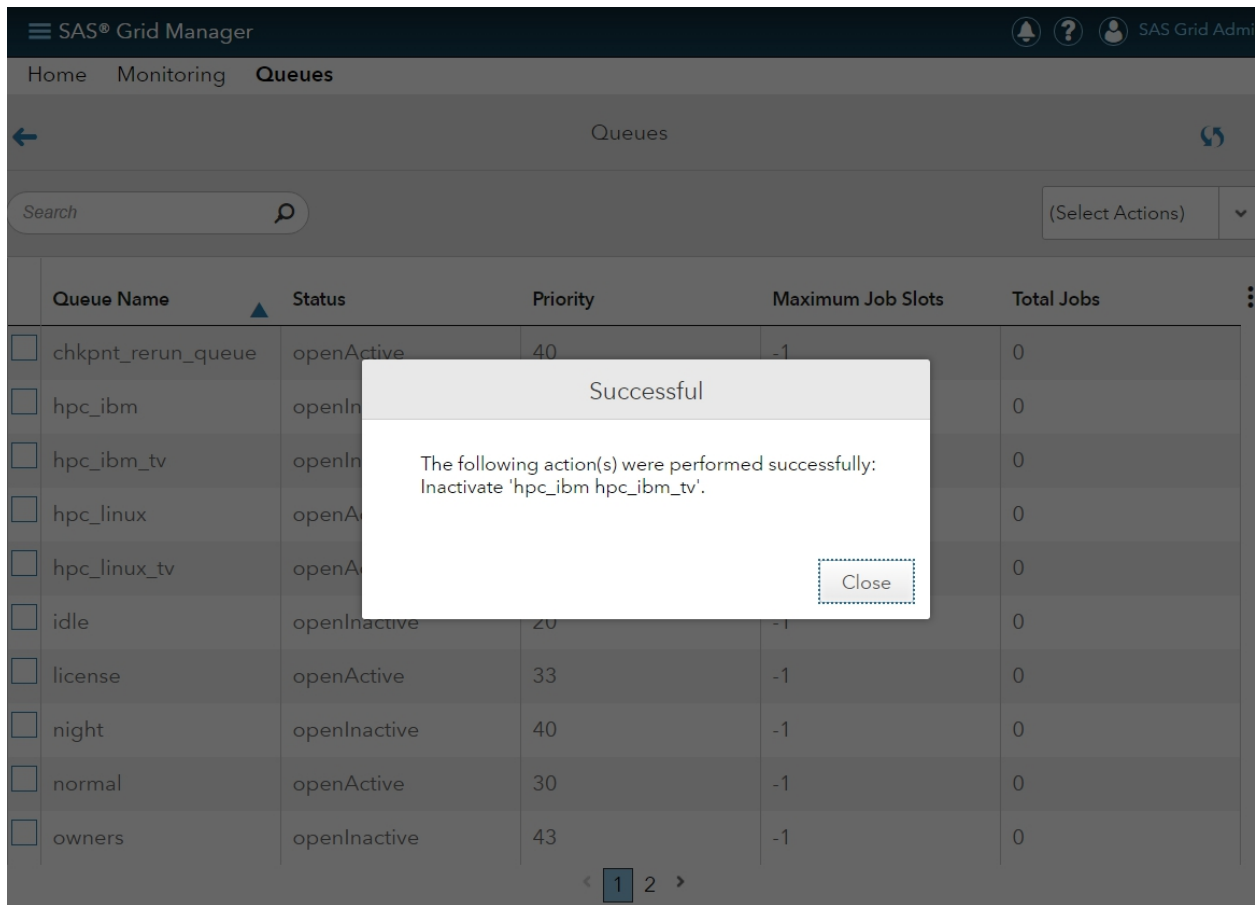**Figure 35: Management Action Confirmation Dialog Box**

Figure 36: Management Action Successful Dialog Box

SAS GRID MANAGER PLUG-IN FOR SAS ENVIRONMENT MANAGER

RESOURCE TYPES

SAS Environment Manager has three different types of resources:

- Platforms
- Servers
- Services

The SAS Grid Manager plug-in creates resources of the Server and Service types. The Server resource type represents the SAS Grid Cluster in the SAS deployment. The Service resource type represents a SAS Grid node in the cluster, which is a child of the parent Server resource.

DATA COLLECTION

The SAS Grid Manager plug-in is one of several agent plug-ins that are delivered with SAS Environment Manager Service Architecture. SAS Grid Manager plug-in only reports metrics from the agent running on the SAS Environment Manager Server machine.

The agent plug-in for SAS Grid obtains its data from Platform Web Services. Because this data represents how LSF sees the entire grid, it makes sense that only one agent reports metrics.

Each agent plug-in has an auto-discovery phase and a measurement phase.

Auto-Discovery

Grid Cluster

For SAS Grid Manager, the existence of Platform Web Services in metadata determines the existence of the SAS Grid in the auto-discovery phase. If Platform Web Services does exist, a Server resource called "**SAS Grid Manager"** is created. You can see this resource on the **Resources → Servers** page in SAS Environment Manager.

Figure 37: Server Resources Page

Initially, the availability icon for the **SAS Grid Manager** resource will be gray if the plug-in is not configured. After the Configuration Properties have been entered and the plug-in successfully communicates with Platform Web Services, the Availability icon appears as a green check mark.

Grid Nodes

Each SAS Grid node shows up as a Service resource under the Services resource tab, with a type of **SAS Grid Manager Host**. These resources are auto-discovered, and are created when the plug-in can communicate with Platform Web Services to retrieve the list of grid nodes in the SAS Grid.

From the SAS Grid Manager Resources page, you can see a list of the SAS Grid nodes under the Inventory tab, as shown in Figure 38.
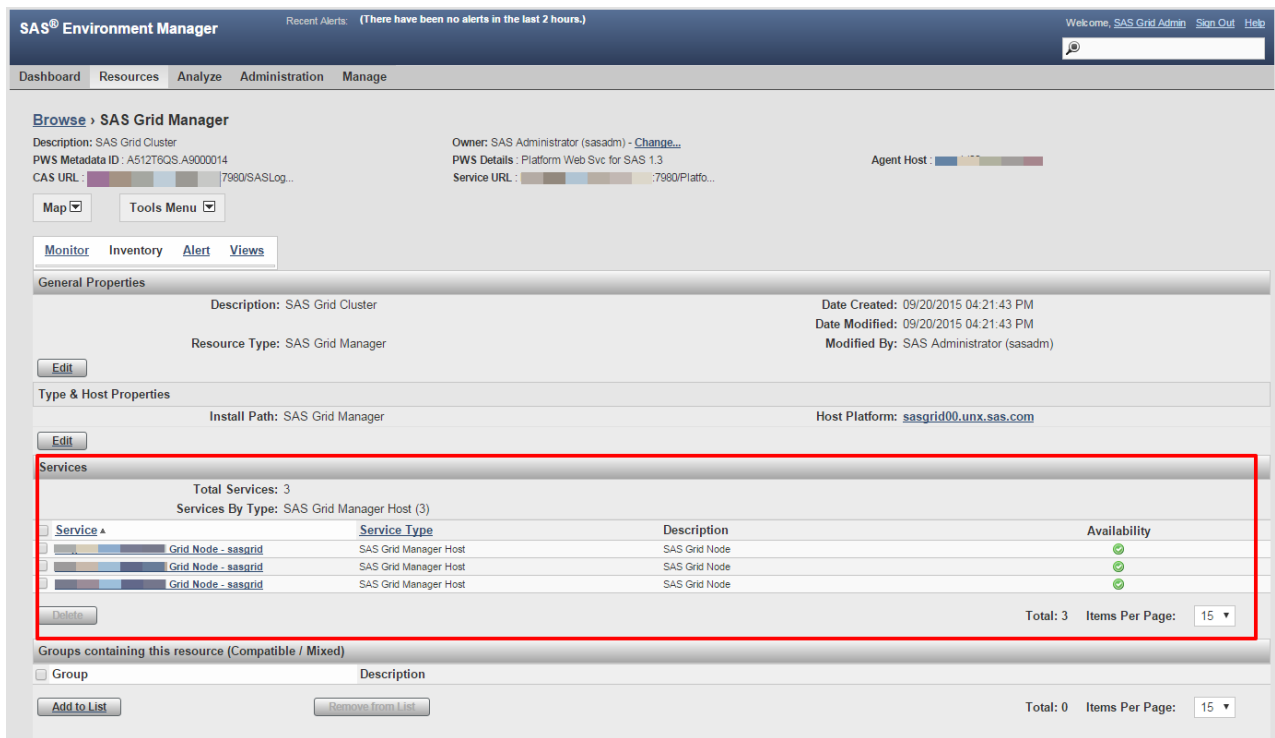
Figure 38: Services (Grid Nodes) under the SAS Grid Manager Resource

Measurement

This part of the plug-in periodically reports the metrics. These metrics provide the data necessary for generating time series graphs and for creating alerts.

The following table shows the collected metrics and default collection intervals for both types of Grid Resources:

Metric	Default Interval	SAS Grid Manager	SAS Grid Manager Host
Availability	1 min	available	available
CPU Factor (cpuf)	12 hour	n/a	available
CPU Utilization (ut)	1 min	available	available
Interactive Idle Time (it)	1 hour	n/a	available
Is Master	1 hour	n/a	available
Jobs Complete	5 min	available	available
Jobs Pending	1 min	available	n/a
Jobs Running	1 min	available	available
Jobs Suspended	5 min	available	n/a
Jobs System Suspended (ssusp)	5 min	n/a	available
Jobs User Suspended (ususp)	5 min	n/a	available
Load Average (r15m) - Processes per 15 Minute	5 min	available	available
Load Average (r15s) -	1 min	available	available

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Processes per 15 Second			
Load Average (r1m) - Processes per 1 Minute	1 min	available	available
Login Sessions (ls)	5 min	n/a	available
Max Job Slots Available	1 hour	available	available
Max Physical Memory (maxmem)	1 hour	available	available
Max Swap Memory (maxswp)	1 hour	available	available
Number of CPUs (ncpus)	12 hour	n/a	available
Number of Cores per Physical Processor (ncores)	12 hour	n/a	available
Number of Local Disks (ndisks)	12 hour	n/a	available
Number of Physical Processors (nprocs)	12 hour	n/a	available
Number of Threads per Processor Core (nthreads)	12 hour	n/a	available
Physical Memory (mem)	5 min	available	available
Swap Memory (swp)	5 min	available	available
System IO (io) - KB per sec	1 min	available	available
System Paging (pg) - Pages per sec	1 min	available	available

Table 5: Default Metric Collection Time Intervals

The collection intervals can be changed from any Grid Resources page by navigating to **Monitor → Metric Data → Show All Metrics** (see Figure 39):

- Select the metrics by selecting the check box to the left
- Enter the "Collection Interval for Selected" in the box at the bottom of that page
- Note: the smallest interval collection time is 1 minute

Figure 39: Changing Default Metric Collection Intervals

Configuration Properties

LSF Administrator credentials are required for measurement to occur. The credentials are needed to communicate with Platform Web Services, which is used to auto-discover **SAS Grid Manager Host** Service resource types in the cluster and to report metrics for all grid resources.

The credentials can be entered by clicking **Inventory → Edit** (found under the **Configuration Properties** section) from the **SAS Grid Manager** resource page. (See Figure 40 and Figure 41.)

Figure 40: Finding the Configuration Properties
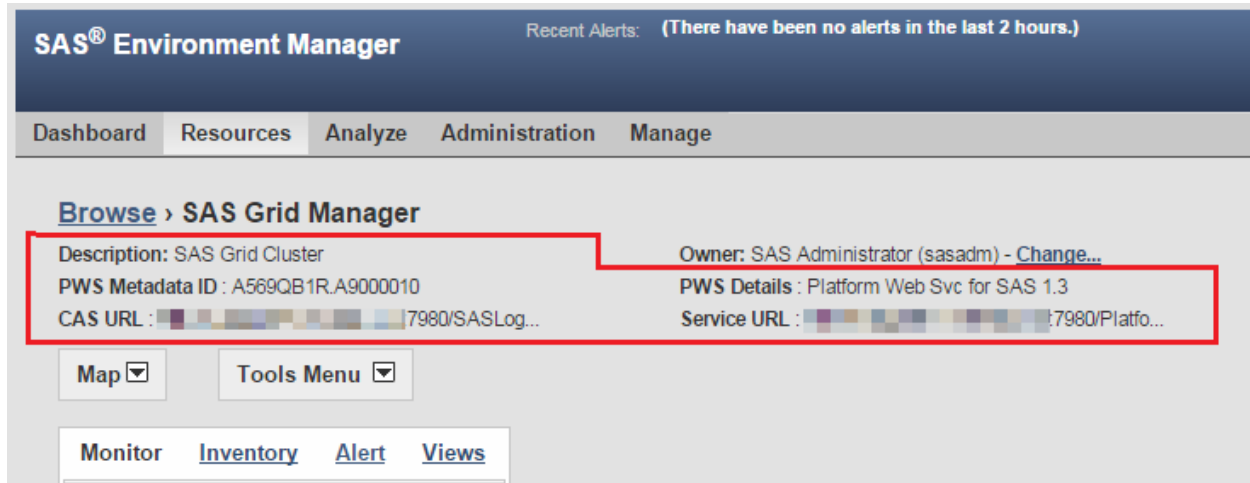
Figure 41: Editing the Configuration Properties

Custom Properties

Custom properties are non-editable properties at the top of each Grid resource page that show information retrieved from SAS Metadata about Platform Web Services, the SAS Logon Server, and Grid Cluster.

Figure 42: Custom Properties

GRAPHS, ALERTS, AND REPORTS

Graphs

Time series graphs are created by the SAS Environment Manager Server from the metric data that is periodically collected from the agent plug-in. The graphs appear under the **Resources** tab in Environment Manager because SAS Grid Manager and the SAS Grid Manager hosts are recognized as resources by SAS Environment Manager.

Grid Cluster

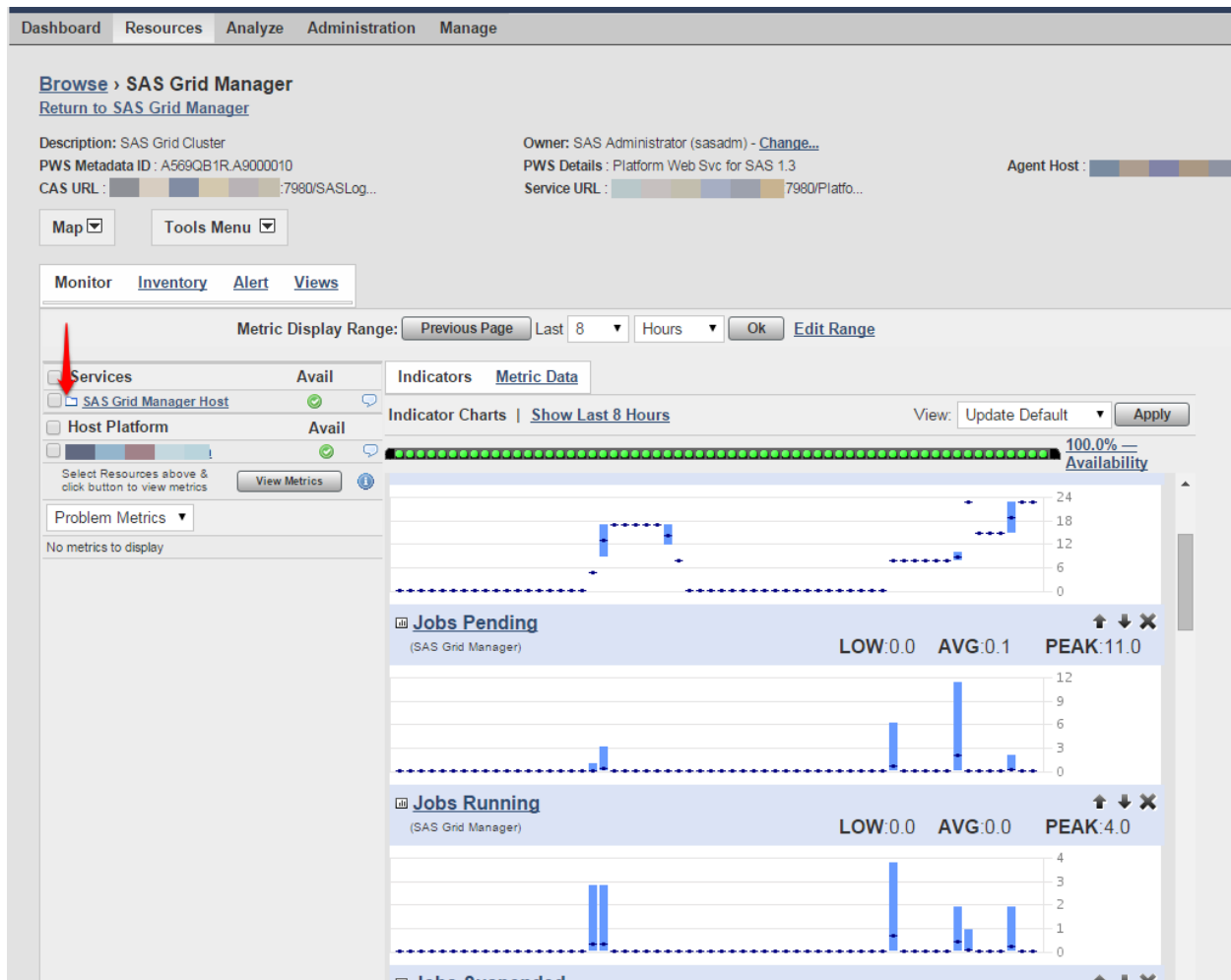View the generated graphs on the **SAS Grid Manager** Resource page by clicking **Monitor → Indicators**.

Figure 43: Graphs for SAS Grid Manager Metrics

Grid Nodes

To view the graphs for the grid nodes in the cluster, click the **SAS Grid Manager Host** link from the **SAS Grid Manager** Resource page.

The **SAS Grid Manager Host** link might have a folder icon next to it, which indicates that multiple SAS Grid Manager Host Service resources exist. Clicking on that grouping link displays a Monitor page for all the grid nodes. Click an individual grid node to view the host-specific metrics collected for that node.

Detailed View

A detailed view of the graph appears when drilling into the metric name on the graph.
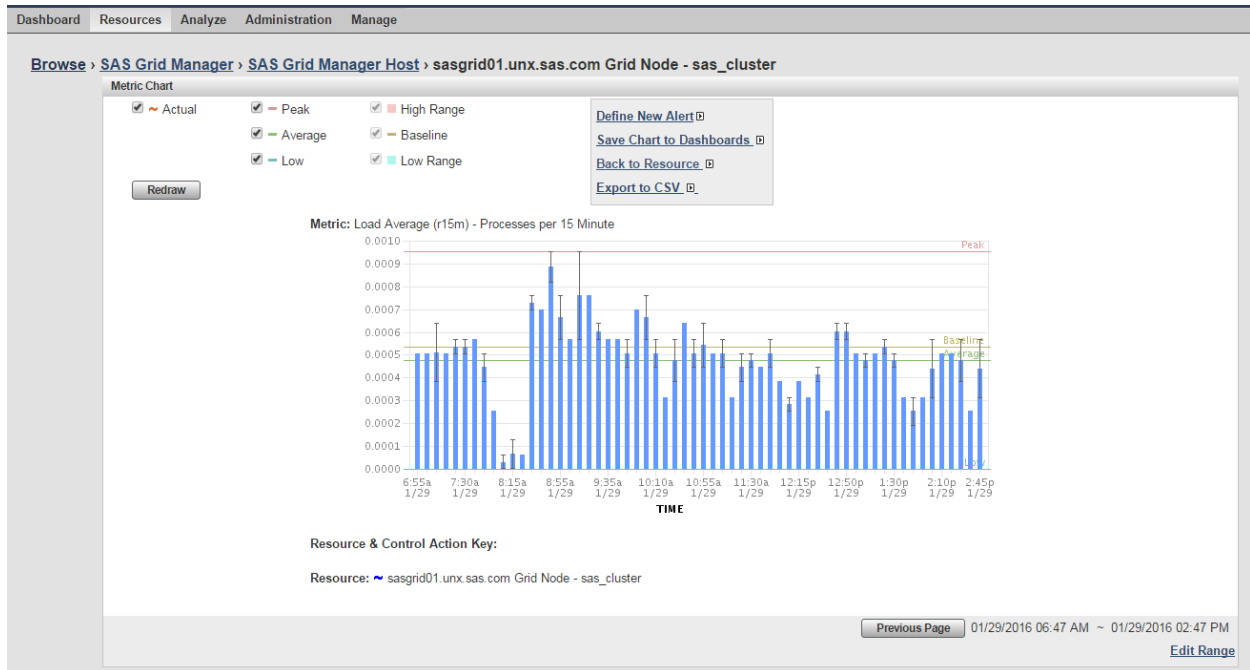
Figure 44: Detailed Graph View

Alert Center

To create an alert definition based on any of the metrics reported for the SAS Grid:

- Click on the resource that an alert will be created for. A resource can be either:
    - The parent SAS Grid Manager Server resource
    - An individual SAS Grid Manager Host Service resource (child of the above-mentioned server resource)
- Click **Alert → Configure → New**
- Refer to Working with Resource Alerts in *SAS Environment Manager User's Guide*.
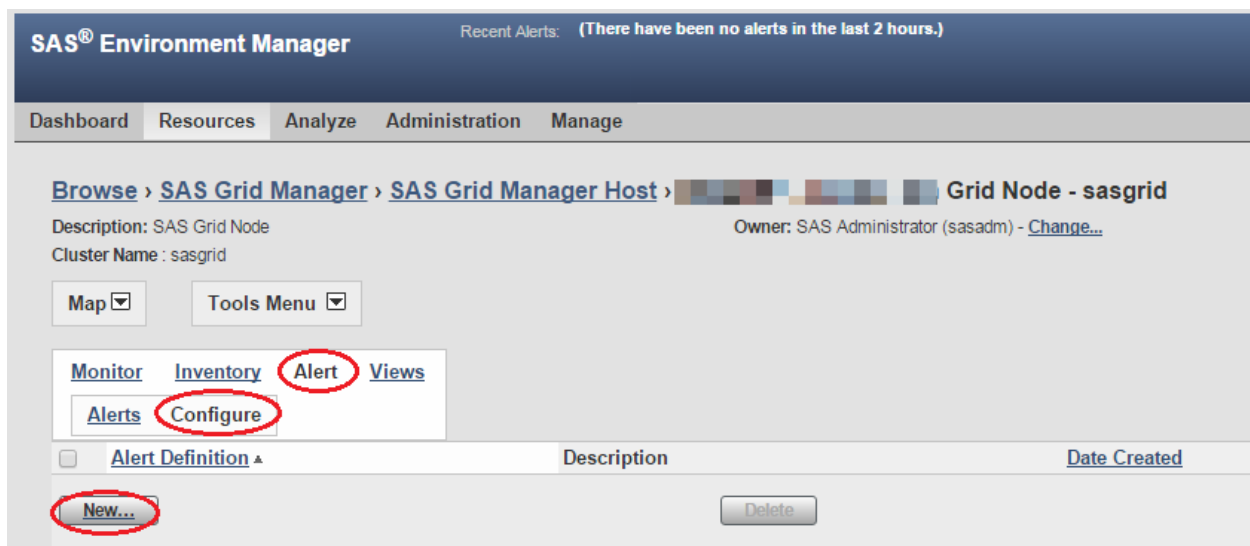

Figure 45: Creating Alert

From here, a new alert Definition can be created based on a set of conditions that must be met for any Metric that is collected for that particular SAS Grid resource.

Figure 46: New Alert Definition

Report Center

Also, advanced reports can be created using the Environment Manager Service Architecture, which can be found under **Analyze → Report Center**.

This tool allows multiple metrics to be plotted on one graph using stored processes. Report Center applies to any metric collected by SAS Environment Manager.

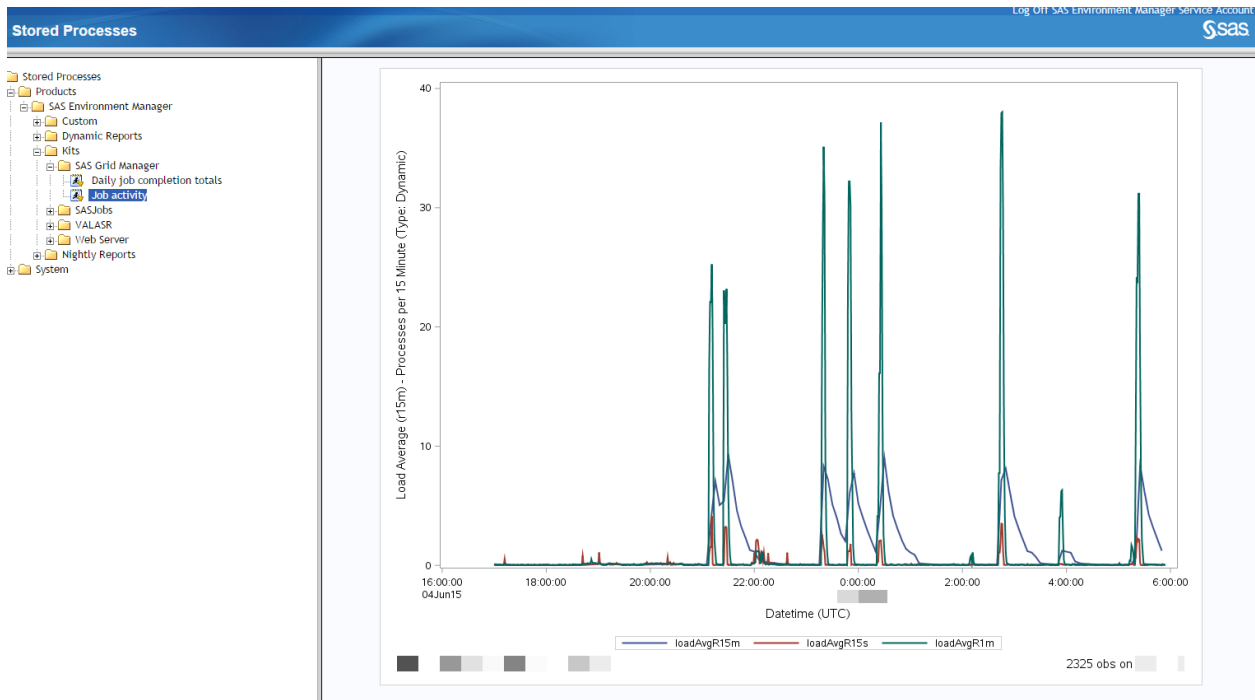Only SAS Environment Manager administrators can view the Report Center.

Figure 47: Report Center Generated Graph Based on Multiple Metrics

CONCLUSION

The release of SAS 9.4M3 brings with it a greatly simplified SAS Grid Manager administration experience. In addition to providing a comprehensive set of features and functionality for SAS Grid Manager administrators, SAS 9.4M3 also provides non-administrative users with the ability to monitor the status of their own, and only their own, SAS Grid jobs. This is a function that hasn't been possible in the past.

From LSF and high-availability configuration; to SAS Grid monitoring and management; to graphs, alerts, and reports; all aspects of SAS Grid Manager administration can now be accomplished through a single, unified, web-based interface that has the same look-and-feel as other SAS web applications.

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RECOMMENDED READING

- Additional information on SAS Grid Computing. Available at
  http://support.sas.com/rnd/scalability/grid/index.html

- SAS Grid Computing in SAS® 9.4, Fourth Edition. Available at
  http://support.sas.com/documentation/cdl/en/gridref/67944/PDF/default/gridref.pdf

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