

Graphical Facility Information Center (GraFIC™)

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Introduction

The Graphical Facility Information Center (GraFIC™) is an information system that provides an inexpensive and flexible method of remotely verifying complete “up-to-the-minute” inventory status of stored items and facility assets. In addition, GraFIC™ provides features needed for day to day management of storage and other facilities. GraFIC™ combines an easy to use graphical user interface with extensive online help so that users need little training. GraFIC™ can be configured to work with most sensor systems used to monitor facility assets.

Some of the features of GraFIC™ are:

- Real-time alarm notification
- Multi-level views of facility status (overview to detail)
- Long-term storage and retrieval of inventory data
- Linking of procedures to associated facility areas
- Space planning and management
- Easy update of facility configuration information
- Many built-in reports that can be viewed on-screen or printed

Although GraFIC™ was originally developed to manage storage facilities for Special Nuclear Material (SNM) at the Oak Ridge Y-12 Plant, it has many potential applications. GraFIC™ would be useful for any facility which houses valuable assets or dangerous items. Some examples are law enforcement agency evidence lockers, military weapons storage facilities, and art museums.

Background

Since the end of the Cold War, one of the Oak Ridge Y-12 Plant’s major missions has been the storage of SNM. Department of Energy (DOE) orders require that the status of the SNM inventories be confirmed periodically. This inventory confirmation provides assurance that the SNM is secure and has not changed. Confirmation of inventory status involves the measurement of physical characteristics of the stored material, in this case weight and radiation level. These measurements

are currently done manually, which is a very expensive task, both in terms of time and in number of people required. In addition, there are security and safety concerns when the stored items are measured manually.

The Continuous Automated Vault Inventory System (CAVIS) was developed to provide a way of remotely performing the inventory confirmation. CAVIS is a hardware and software sensor system that is capable of obtaining weight and gamma ray signature measurements from stored SNM. However, the CAVIS system by itself provides no user interface and is limited to very short-term storage of sensor readings. The GraFIC™ system was conceived to provide those elements missing from CAVIS - an easy-to-use user interface and long-term storage of sensor readings and other data. In addition, GraFIC™ has been designed to provide intelligent facility management features for the storage areas. Early-on the GraFIC™ team recognized that the features of GraFIC™ could have broader application, and so the system was designed to permit easy adaptation to other facility environments.

Initial Implementation

The initial implementation of GraFIC™ works with the CAVIS sensors to monitor SNM that is stored in Modular Storage Vaults (MSVs) at the Oak Ridge Y-12 Plant. An MSV (see Figure 1) is a concrete slab that contains twenty cells, each of which holds a canister of SNM. Each cell has a weight sensor, a radiation sensor, and a temperature sensor. The sensors are monitored by an embedded microprocessor (called a Sensor Concentrator) which is attached to the side of the vault. These vaults are placed in stacks, ranging from one to five vaults in height, and a concrete lid is placed on top of each stack.

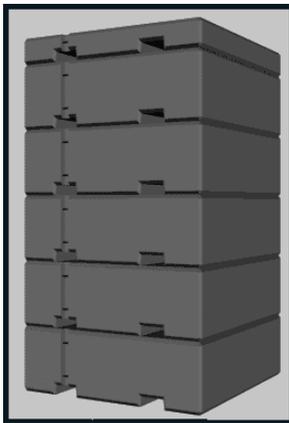


Figure 1 Modular Storage Vault Stack

The GraFIC™ system, which interfaces with the CAVIS sensor concentrators, is designed on a client-server model. The server and all client software can be run on a single system, but a more typical arrangement would have at least three processors:

Sensor Polling and Configuration System (SPCS)

A GraFIC™ installation may include one or more of these front-end processors, each of which acquires sensor readings from up to 120 concentrators. The SPCS commands the concentrators to scan all sensors at periodic intervals. The readings from these scans are saved in medium-term storage (for a few days) and sent to the Database Server for long-term storage. In addition, the SPCS continually monitors the sensors via the concentrators and reports out-of-limits readings to the Database Server for instant alarm notification. The SPCS accepts commands from the Database Server to do such things as alter its scan rate, perform an immediate scan, etc. The SPCS software was developed using Microsoft Visual C++.

Database Server (DBS)

The main purpose of the Database Server is to control client access to the relational database. The database is logically partitioned into three subsets:

1. One group of data holds the current facility configuration and the current facility status. These tables are normalized as is typical of a relational database.
2. The second group of tables holds facility configuration and status history. Each of these tables is denormalized so it can serve as a stand-alone log. This data is kept for thirty days and is provided for use in problem resolution.
3. The third group is made up of a single table, the DAILY_ARCHIVE table. This table, which is also designed as a stand-alone log, contains inventory data (one row per sensor per day). This information is kept online for a year and then is archived to offline storage.

When sensor readings are stored in the database, the DBS converts each reading to engineering units and checks the reading against the sensor's alarm and warning limits. If an alarm situation is detected, this is recorded in the database. The historical logs are automatically updated when the current facility configuration or status is updated. These functions are implemented as Oracle Triggers, written in the PL/SQL language.

Workstation

A GraFIC™ installation may have one or more workstations to provide access to the user interface. These workstations may be placed in locations which are convenient to the workers who need to use them. The user interface was developed using PowerBuilder 5.0 and HelpBreeze 2.0b, by SolutionSoft, was used to develop the help information.

A typical GraFIC™ installation is depicted in Figure 2.

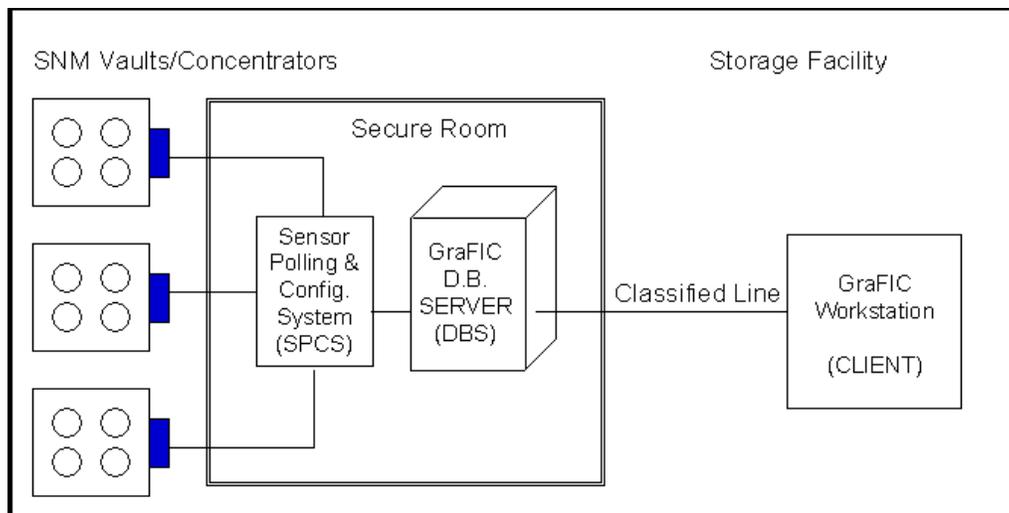


Figure 2 Example GraFIC™ System Layout

User Interface

The user interface is the most visible aspect of the GraFIC™ system, and so deserves a deeper look. The user interface provides three main services: update of facility configuration information, notification of facility status, and built-in reports.

Facility Configuration Update

The user interface allows the user to enter and update information about the facility configuration, items stored in the facility, and the sensor system used to monitor the items. The input windows have been designed to be as intuitive as possible and context-sensitive help is provided to answer the user's questions.

Facility Status

There are two main displays that give an overview of a facility's status. The first of these is the alarm display (see Figure 3). This display, which can be viewed in either tree or table form, lists all sensors that currently are in alarm state. From this display, the user can call up more detailed displays for more information. One of these detailed displays is the stack display, which shows the number of vaults in the stack and the alarm status of each vault.

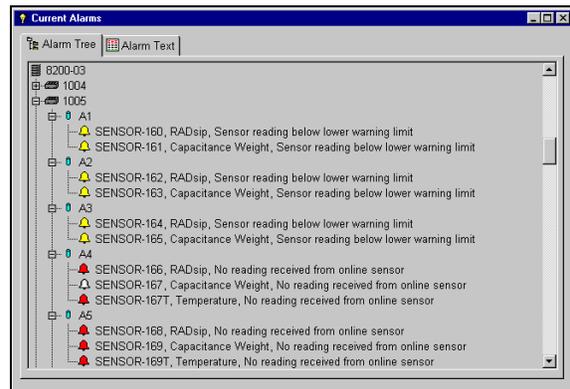


Figure 3 Example Alarm Tree Display

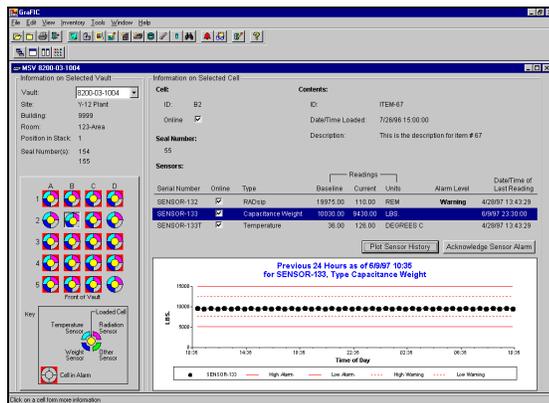


Figure 4 Example Sensor Reading Display

Another detail display is a sensor reading display (see Figure 4), which shows the current status of each individual sensor, including the current reading value and the current alarm state. Information about the stored item being monitored also appears on this display. In addition, the user can view a plot of sensor readings over time for a selected sensor and can print an "Incident Report" for a selected alarm. These last two features provide assistance for diagnosing the causes of alarms.

The second overview display is the floor plan map (see Figure 5). Each floor of each building in the monitored facility has a map that is a to-scale layout of the floor, with positionable icons representing the MSV stacks. The state of each stack's icon represents its current alarm status. All of the detailed displays that can be reached from the alarm display can also be reached directly from the floor plan map. In addition, the user can display information about rooms, such as usage, entry requirements, and any procedures applicable to storage operations in that room. Similar information can be displayed for the building as a whole.



Figure 5 Example Floor Plan Map

A user who has the privilege to do so can “acknowledge” one or more alarms. Acknowledgement of an alarm indicates that someone has noted the alarm condition. An alarm condition will not end until the sensor reading has returned to normal and the alarm has been acknowledged.

GraFIC™ provides an asset locator function which allows the user to find the location of any stored item. The user enters all or part of the identifier of the item and GraFIC lists all items which match. The user can then select an item from this list and display its floor plan map, its stack display, or its sensor reading display. The user can similarly locate stacks, vaults, building, rooms, etc.

The storage management feature will be used by facility managers to plan for future storage needs. Using this feature, a user enters required storage constraints, and GraFIC™ will determine the number, location, and size of available free areas which meet those constraints.

Built-In Reports

Several built-in reports are supplied with the GraFIC™ system:

- Inventory Report - contains the status of the stored inventory for the selected date
- Alarm Report - contains the historical or current alarms for the selected area
- Alarm Criteria Report- contains the current or historical alarm limits for the selected area
- Polling Interval Report - contains the history of the SPCS polling interval setting, with the current setting listed first
- Seal Report - Contains the history of tamper indicating devices in use in the selected area
- Incident Report - Contains a list of sensor readings which were taken just prior to the occurrence of an alarm, all sensor readings which were taken while the alarm condition was in progress, and sensor readings which were taken from the sensor just after the alarm condition ended for the selected alarm

- Access Control List Report - Contains a list of all GraFIC™ users and their privileges

Drop-down lists and radio buttons are provided for the user to enter selection conditions for most reports (see Figure 6). When the user requests a report, it is displayed on-screen and may also be printed .

Commercially available tools may be used to provide ad-hoc query and reporting support, if such support is needed.

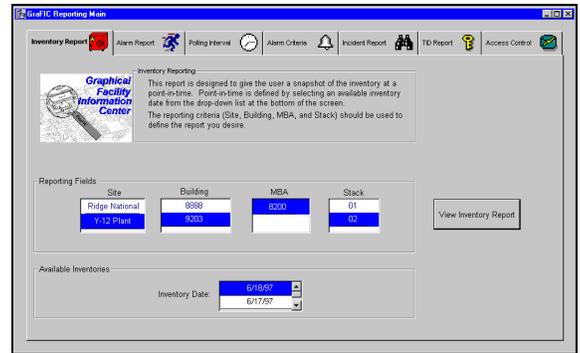


Figure 6 Example Report Selection Window

Security

Because GraFIC™ is designed to run on a Windows NT system (or systems), the well-known security features of Windows-NT are available. The GraFIC™ application is built on a multi-tiered security model. GraFIC™ users fall into several categories and the user interface features available depend on the user's category. Since the security model is implemented using Oracle7™ roles, this protection is enforced even when other products, such as browsers or ad-hoc query tools, are used to access the database. The GraFIC™ application enforces a two-person rule for facility configuration updates. Under this rule, two privileged users must log onto GraFIC™ before updates can be made.

Summary

The GraFIC™ system is being developed initially to provide fast and inexpensive SNM inventory status confirmation, real-time alarm notification and other storage facility management features for the Oak Ridge Y-12 Plant. The system also has many other potential applications. The GraFIC™ project team has designed the system so that it can be easily adapted to fit any facility or inventory situation. Display details are easily adjusted to reflect any storage environment. GraFIC™ can also be configured to interface with existing databases to provide access to already collected facility and personnel information without the need for duplication.