The Alarm System for the SPring-8 Storage Ring

A.Yamashita, T.Fukui, K.Kobayashi, T.Masuda, A.Taketani, R.Tanaka and T.Wada
SPring-8, Kamigori, Ako-gun, Hyogo 678-12, Japan

Abstract

The alarm system for the SPring-8 storage ring is described. The system watches status of equipment, gives a warning to operators when a trouble happens, records it and analyzes past troubles. The system is built on the database system using client/server scheme.

1 Introduction

The SPring-8 storage ring (SR) ended its commissioning phase and began to feed synchrotron light to users in October 1997. The alarm system has been monitoring the 4200 signals of the SR since the beginning of the commissioning in March 1997.

The main purpose of the system is giving alarm to the operators when an equipment failure happens. Secondly the alarm system enters current status of alarm to the on-line database and records alarm history for off-line analysis.

The alarm system gives no feedback to the equipment. Independent hardware system manages interlocks for safety or equipment protection.

The alarm system consists of the distributed processes on workstations on the SR control network. [1] Each process is a client of the SR database system. [2]

2 Signal to watch

The poller/collector system [3] collects data from equipment and enter them into the on-line database. The alarm system reads the current data of equipment from the on-line database, not from equipment directly.

The alarm system watches two kinds of signals, i.e. digital and analog signals. A digital signal contains up to 30 independent on/off status in one 32 bit integer. The alarm system loads nominal digital signals and bit masks to be set. It compares the nominal digital value to the value read from the on-line database and writes alarm information if it is different.

Two bits out of the 32 bit integer are reserved for special purposes. One bit means failure to take data and another means the signal is off state for some reasons. The alarm system gives an alarm when a failure is detected under any alarm condition. The alarm system ignores the signals with the off bit.

Analog signals are expressed by a 32 bit single precision floating point value. Analog values are watched by either of five kinds of threshold:

- Absolute difference to another signal in on-line database,
- Relative difference to another signal in on-line database,
- Absolute high,
- Absolute low,
- Absolute high and low.

The alarm system makes an alarm with independent alarm conditions and no combinational alarm.

3 Equipment subgroup

We define *equipment subgroups* to manage alarm conditions under the equipment groups. Here, an equipment subgroup means a group of equipment which have the same status of alarm at the same time. For example, RF equipment group has four equipment subgroups which have the subgroup status independently. A RF station is a one of RF subgroups and it can have three sub group status i.e. on, off and standby.

A set of alarm signal conditions is defined for one subgroup status. Here, an alarm condition can mean thresholds for analog signals or nominal values for digital signals are exceeded. The alarm system reads the current status of each equipment subgroup from the parameter database. Then it loads a set of alarm conditions which correspond to the subgroup status.

4 Two levels of alarm

The alarm system issues two level of alarm i.e. warning and alert. An alert is more serious than a warning. A yellow signal is displayed on screens when a warning happens and a red signal is displayed for an alert. In addition to the display, a voice alarm warns to operators when an alert happens.

5 Alarm processes

The alarm system consists of four parts, the alarm watch, the alarm watch control, the voice alarm and the alarm display. Each process communicates with each other through message queue [4] or the database. Though those processes can run at any workstations on the network, we assign a workstation for alarm watch to ease management.

5.1 Alarm control panel

One equipment group, i.e. magnet, vacuum, RF or safety has only one alarm control panel. At the beginning of the alarm watch, an operator opens alarm control panel on X-window. The alarm control panel starts an alarm watch process and communicates with it through the message queue.

The operator can change the signal to watch the watch cycle and the alarm conditions. When the control panel accepts changes from the panel, it updates data on the parameter database and passes it to the alarm watch process.

The control panel receives status from the alarm watch process and displays changes on the screen.

5.2 Alarm watch process

An alarm watch control panel forks the alarm watch process, the heart of the alarm system.

The alarm watch process interacts only with the database and the alarm control panel. It loads alarm conditions from the parameter database at the beginning of the process.

The alarm watch process executes the following job every 5 seconds.

1. Check if the subgroup status has been changed since the last watch by comparing the time stamp of the database with current time. We use the clock on the database server as the standard time of the system to prevent trouble occurring by different times on different computers.
2. Read the current status of the equipment from the on-line database.
3. Compare to them to the alarm condition.
4. Write the alarm information to the alarm tables of the on-line and the archive database when it detects an alarm.
5. Records the end time of the alarm to the archive database when the alarm turns off.

When the alarm watch receives a message from the control panel, it reloads the alarm conditions for the signals marked by the control panel from the parameter database.

Another message from the alarm control panel can change the watch cycle.

5.3 Voice alarm

An independent process, *the voice alarm* watches the on-line alarm status and notifies operators when an alarm happens. This process is limited to one in the entire system.

A panel on X-window is displayed when the process starts. The panel has on/of buttons for each equipment group.

The voice alarm process watches the on-line alarm table in 5 second cycle. It issues a Remote Procedure Call (RPC) to a voice synthesizer to say a simple message like “alarm at magnet group” when an alert happens.

The messages continue in 10 second cycle. An operator can pause them for 120 seconds pushing a group button on the panel. However it does not end until the alarm stops. We did not employ “acknowledged and don’t say anymore” strategy because we are afraid operators would forget the alarm.

5.4 Alarm display

The alarm display process shows alarm status graphically, statistics of alarm and detailed information for signals as shown in Figure1.

Unlike the alarm watch process, unlimited number of alarm display processes can run everywhere on the SR control network.

The alarm display process shows one X-window based panel which consists of three parts i.e. graphics, statistics and signal names. A clock is also displayed to check the process running.

Operators can see alarm status at a glance with a graphical part of the panel. The graphics illustrates the SR with the vacuum cell, the magnet power supply stations and the RFstations. Troubled parts fill with either red or yellow.

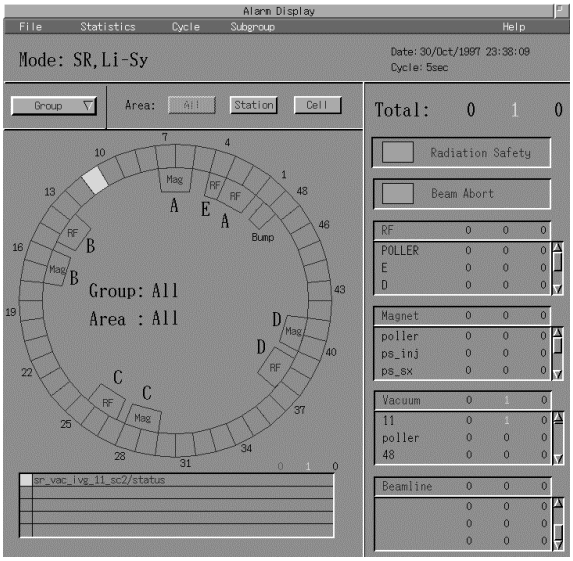

Figure1. Alarm display

The statistical part of the display shows number of warnings, alerts and their sum grouped by equipment subgroups. Operators can also see a graph of number of alarms vs time.

The names of alarmed signal are displayed in the signal name part. When an operator points and clicks the name of alarmed signal with a mouse, detailed information about the signal like the current value, the alarm conditions and the bit information are displayed on another pop-up window.

5.5 WWW

Equipment specialist cannot see the alarm display panel from the outside of the SR control network because it is protected by the firewall. We built another way to see the alarm status from WWW. Although it has no graphical capability, a user can see the current status and the history of alarms at their office via WWW common gateway interface (cgi) programs.

6 Parameter entry

The experts set the alarm conditions to the database in two ways. One is using alarm control panel interactively but it′s rather ineffective. Another is to write a spread sheet for alarm conditions. A utility program written in Python [5] converts the spread sheet file to the parameter database. The initial alarm conditions were set by this method.

7 Conclusion

We built an alarm system for the SR system fully based on the database system. The database system makes the structure of the system simple and easy to extend. The alarm system has been in operation since March 1997. It has been working with no major trouble. It will be extended to watch other system like beamline and injectors.

Acknowledgments

We greatly appreciate members of Mitsui Zosen System Research Co. Ltd., for their assistance in constructing this system.

References

[1] T.Fukui et.al., in these proceedings of ICALEPCS '97, Beijing, China.

[2] A.Yamashita et.al., "The database system for Spring-8 storage ring control", in these proceedings of ICALEPCS '97, Beijing, China.

[3] A.Taketani et.al., "Data acquisition System with Database at the SPring-8 Strorage Ring" in these proceedings of ICALEPCS '97, Beijing, China.

[4] R.Tanaka et.al., P201, The proceedings of ICALEPCS '95, Chicago, ILL,USA 1995

[5] http://www.python.org/