TROUBLE HISTORY DATABASE OF HIMAC

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Abstract

HIMAC (Heavy Ion Medical Accelerator in Chiba) is a medical accelerator facility at NIRS. When a machine trouble happens, it is very important to find the solution for recovering from the trouble promptly in order to minimize the unexpected down time. For that purpose, we made a trouble history database which can show us the past solutions for the same kind of troubles.

As the current database is widely used by HIMAC operators, many improvement plans are required: a system to share repair progress follow up of failed parts, a link to official trouble reports, and so on. In this presentation, I will introduce the current trouble history database and discuss about the improvement plan of the database system.

INTRODUCTION

About HIMAC

HIMAC supplies carbon beam mainly about 290 ~ 400 MeV/u for cancer therapy during the day time from Monday to Friday. At night time and weekend, it supplies many kinds of ion beams for physics and biological experiments. For more details about HIMAC, see NIRS web site [1]. Figure 1 shows a layout of HIMAC. It largely consists of four parts: Injector part (INJ), Synchrotron part (SYN), High Energy Beam Transport (HEBT) part, and Irradiation part (IRR). HIMAC has two synchrotron rings and beam transport lines, so we call these parts USYN/LSYN and UHEBT/LHEBT. I will discuss trouble history database about INJ part, SYN part and HEBT part.

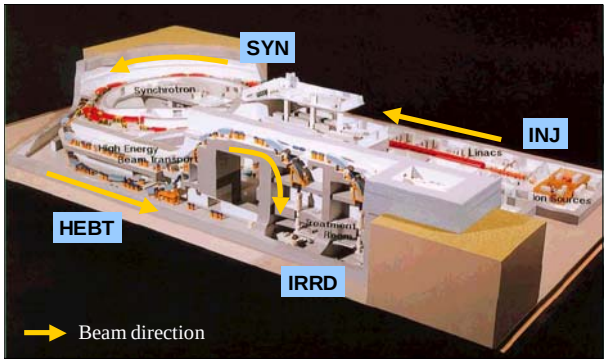

Figure 1: Layout of HIMAC

Purpose of Trouble History Database

Accelerator operators who belong to SYN/HEBT group were divided into three teams: Power supply team (includes magnet and RF), Monitor team (covers vacuum and cooling water) and Control system team (includes computer and network). In a similar way, operators of INJ group were divided into three teams: RF team (also vacuum and monitor), Ion source team (2 ECRs, 1 PIG and low conductivity cooling water) and Control system team (includes computer and network). All operators belong to one team, and they are in charge of the respective part. We have to take day shift which consists of 2 operators and night shift of 3 operators [2]. Actually, all of the shift members don't have the perfect knowledge about another team, so there is necessity for a kind of trouble shooting tool in case of beam down.

One of the most important things in accelerator operation is to minimize the unexpected down time. It depends on how quick the operators can solve the trouble and recover the beam supply. Trouble history database can show the operators how to identify the kind of trouble, how to solve the problem, how many times the similar trouble happens, and so on. Even if the kind of trouble is unknown, the database may show us the hint to solve it.

In order to use the trouble history database as trouble shooting tool, it is also important to develop a system which can be used easily to search or update the trouble information by operators.

Previous Status

Until 2005 when we introduce the present trouble history database, log books and trouble reports were the only sources to know how to fix the trouble in past. The trouble reports were electronic files but they were issued for big troubles (more than 30 minutes beam down) only. In order to search the solution for middle or small troubles (and some of them occur frequently, or some other once in a while), we had to check many log books manually, but it took too much time. In such situation, we decided to develop a search system for past trouble solutions.

CURRENT TROUBLE HISTORY DATABASE

Current System (since 2005)

Current trouble history database which was introduced in 2005 uses WEB server - client system. The specifications of WEB server is shown in Table 1.

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Table 1: Specification of WEB server

Server PC	NEC Express5800/110La
OS	Windows2000 Professional SP4
RAM	384MB
CPU	Pentium II 265MHz
httpd	AN HTTP Daemon Ver. 1.42n [3]
Perl Interpreter	Active Perl 5.8.7 [4]

Trouble database system consists of some data files and CGI scripts. Schematic diagram of database is shown in Figure 2. The data files are simple text file (so-called Flat File Database). CGI scripts written in Perl read or write the text data file if necessary. Operators can search or commit trouble events by web browser. This WEB server is opened for LAN only and can't be used from the Internet world wide.

As shown in Figure 2, this Flat File Database system is very simple and doesn't need to use any Database Management System. And the file size of each CGI scripts is very small (about 10kB).

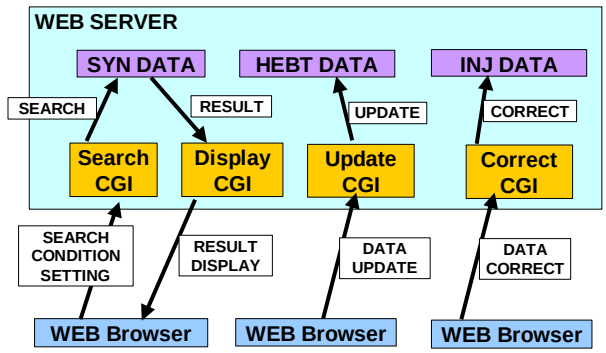

Figure 2: Schematic diagram of database

Table 2 shows the size and the number of included events on the data files. We have been using this trouble history database system since 2005 for SYN and HEBT part. To begin with, we entered almost all the past troubles manually by checking the old log books. This is the reason why the data file for SYN and HEBT parts contains past 10 years' trouble data. As can be seen, the data file size is not so large.

Table 2: Details of flat file data as of Aug 2007.

	SIZE	DATE FROM	NUMBER OF TROUBLE DATA ENTRY
SYN	317kB	1993 ~	1816
HEBT	200kB	1994 ~	1561
INJ	60kB	2006 ~	120

Due to historical reasons, for INJ part, trouble history database system has become available since 2006 but past troubles have not been included. INJ part operators are planning to input past trouble data near future. The performance of search response depends on file size because search CGI read all the data from data file. File size for SYN part is five times larger than INJ part, but actual response speed is not so different in such a few hundred kB order. As shown in Table 2, file size to data entry number ratio for INJ part is larger than SYN and HEBT part. This is because that a big trouble in INJ part tends to be accompanied by other troubles, so one trouble data has much information.

Figure 3, 4, 5 and 6 show the typical display of trouble history database. I was in charge of this trouble history database development and I spent about 1 month before releasing the first version. As our main job is accelerator operation, we have to take about 1 day shift and 1 night shift per week. So I need to use mainly other time (so-called maintenance job) than the on-shift time for developing the software. Average time for maintenance is about 16 hours per week. About inputting past trouble data for 10 years, three operators spent 6 months for SYN data and 1 operator spent 1 month for HEBT data.

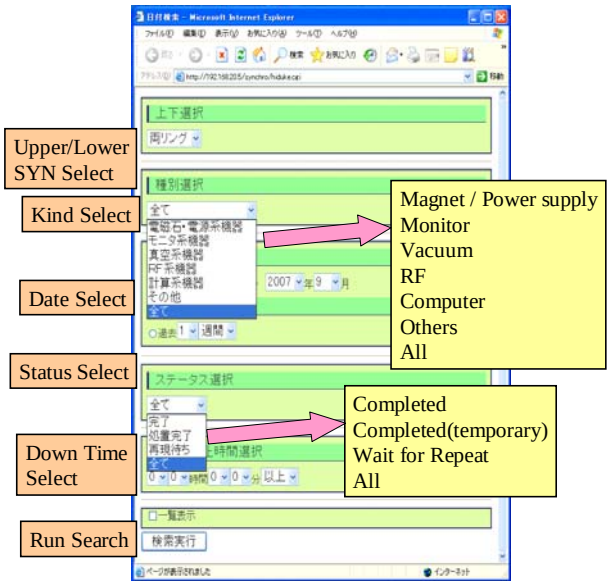

Figure 3: The trouble history database display for search condition setting

Figure 3 shows the display for search condition setting for SYN trouble data. "Kind Select" means classification selection of the device which we want to search. After the search condition setting, we get the trouble information which matches the search condition. This search is useful to check the trouble frequency of a device during the period, or to check what kind of trouble happened during a period. Figure 4 shows the display of search result. Search condition of Figure 4 is shown in Table 3.

Table 3: Search condition of Figure 4

SYN select	USYN
Kind select	Magnet / Power Supply
Date select	Apr. 2007 ~ Aug. 2007
Status select	All
Down time select	more than 0 min.
Number of trouble	6

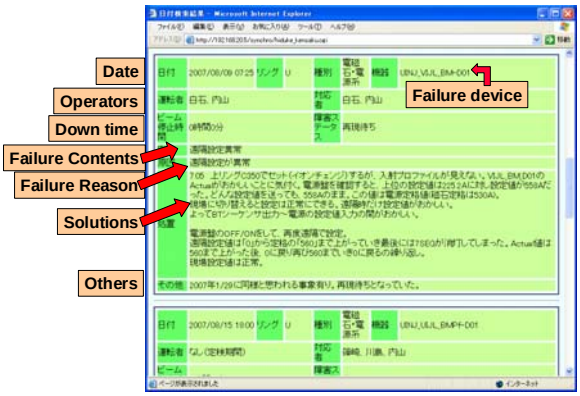

Figure 4: The trouble history database display for search result.

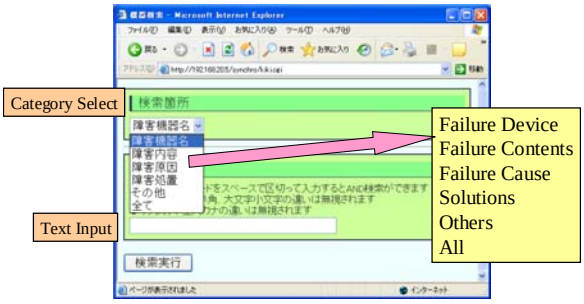

Figure 5: The trouble history database display for text search

Figure 5 shows the display for text search. "Category Select" pull down menu (Failure Device, Failure Contents and so on) has the same category of search result in Figure 4. We can use any kind of character strings for Text Input. We can get the all trouble information which contains the entered character strings in selected category. This search is useful when we know the device name only or some fragmented information about the trouble.

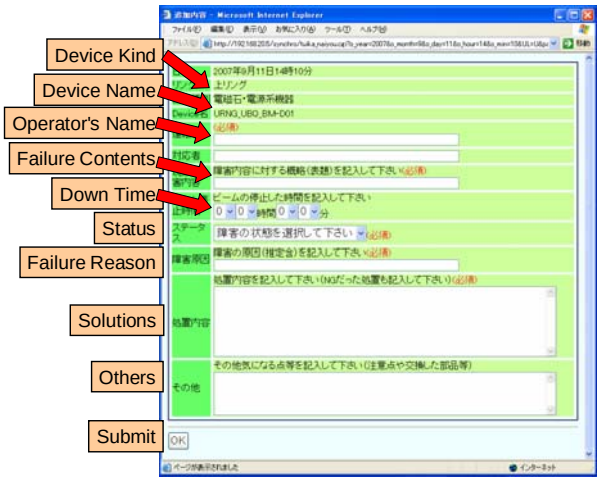

Figure 6: The trouble history database display for trouble event entry.

Figure 6 shows the display for trouble event entry. We can submit the entered data in this input form, and data file which is located at WEB server will be updated. In order to avoid simultaneous access to update same data file from different client (it may cause data destruction), we adopt flock() function which enables exclusive file lock. By using this function, nobody can update the data file while somebody is updating it. As access frequency is not so high, exclusive file lock is enough to prevent data files from breakdown. Until now, the data file destruction has not occurred.

Merit in This System

By using this system, we can search the past trouble by date or by character strings. It is very useful to search the solution by troubled device name because it contains many experience and wisdom of experts. In addition, because of WEB server-client system, we can search or update the database simultaneously from many clients within LAN. Of course, the contents of the database can be used for official trouble reports by copy and paste.

In this system, operators should input all about what they did (including intention and/or reasoning of the act) to fix the trouble whether it was effective or not. This is based on our policy that we should accumulate the know-how as database because mechanical alarm message or operation log which is created by computer automatically is not always adequate for trouble shooting.

Expectation and Actual Status

Thanks to the cooperation of operators, the database is updated even if the trouble is small and doesn't affect beam supply. It then helps operators as a useful tool.

For example, there is a kind of vacuum gauge error which occurs about once per month and it is one of a common small trouble. It is very important to analyse the statistics of frequency about such trouble in order to solve it. By using trouble history database, it becomes very easy to check the statistics.

For another example, when a control system error happened, even an operator who didn't know well about UNIX or VAX command could check the status or solve the trouble because the trouble database contains such information as the command used in similar events etc.

However, the trouble history database can't be updated automatically when a trouble happens because it is located at different network from control system which has error log or alarm log. So operators who deal with a trouble must input all the information about the trouble.

To Be Improved

This system is not opened for external, so only operators can use the information while other staffs may want to use it. In addition, it is difficult to follow the status of repair, investigation or improvement. For example, if a failure device needed to repair or investigate by hardware manufacturer, the operator who was in charge of the device should follow up the status. And the operator also should update the trouble history database according to the status so as to keep the newest data in the database. But actually, all of the trouble data isn't followed strictly.

As shown in Figure 4, current system has only text information. For more detail information, the function which enables us to upload the picture is needed.

FUTURE PLAN

Open for External Network

One of the simple ways to improve current system is to open the database for external network. By this improvement, hardware or software manufacturers can access the trouble history database. They can also check the trouble, operator's solution, trouble status and so on. In addition, they can make a comment about the solution and report the repair or investigation status. By checking the trouble history database which updated by manufacturer, not only responsible operators but also another operators can follow the status. Figure 7 shows the schematic diagram of improvement plan.

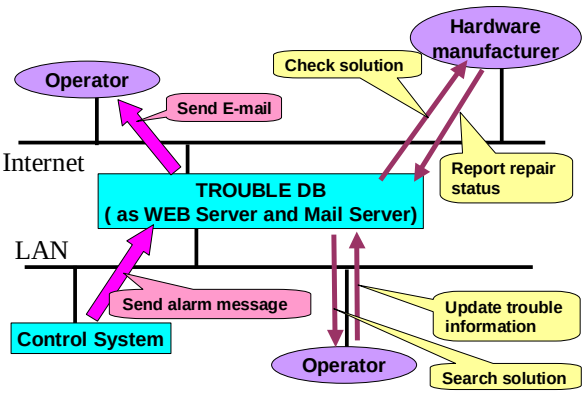

Figure 7: Schematic diagram of improvement plan.

In figure 7, we use trouble history database not only as a WEB server but also as a Mail server. When a trouble happens, control system sends an alarm message to the database. The alarm is recorded as trouble, and Mail server send an E-mail to the responsible operators.

There are some difficulties in this plan, for example, the network security problem. Trouble history database may contain some confidential information, so we must develop the network security policy very carefully.

SUMMARY

We have introduced a trouble history database since 2005 and it contributes our trouble solution. We spend about 1 month to publish this software, and about 6 month to input almost all of past trouble data. For more useful environment, we are planning to improve or add some functions, for example, picture upload, to follow the trouble status, to send E-mail automatically and so on. In order to do these improvements, it becomes very important to consider the network security policy.

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