

# RELATIONAL DATABASE SYSTEM IN THE KEKB ACCELERATOR CONTROL SYSTEM

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## Abstract

A relational database system Oracle was installed in the KEKB accelerator control system. The database contains all the data concerning accelerator components such as magnets, power supplies, vacuum ducts, pumps, control modules and so on. It keeps the history of the equipment, parameters of the component, physical location, electrical characteristics, wire connection list and so on.

It is also utilized to derive control parameters for EPICS such as name of the channel address, converting coefficients and so on. In the KEKB control system, number of control points is so large that it is not efficient to edit configuration files such as EPICS database files and MEDM files (configuration files of control windows). We have developed methods to create these files.

## 1. CONCEPT

In the large accelerator system such as KEKB, the number of data to administrate is very large. It is necessary to have centralized data management system in the control system to maintain consistency of data. Centralized data system also encourages people to share data. We build the central data management system based on RDBMS (Relational Database Management System), "Oracle".

Our goal is to store all the data used in the KEKB system in this database and to configure the KEKB control system using these data.

The KEKB control system uses EPICS (Experimental Physics and Industrial Control System, [1][2][3]) tool kit. EPICS tool kit is a collection of software on which a control system with a distributed runtime database is built. Each EPICS tool has its own configuration file. EPICS runtime database is also configured using a configuration file. In the KEKB control system, RDBMS provides various parameters to the EPICS database (device addresses, constants, and calibration data...). This scheme makes mass production of the EPICS database easy. RDBMS is also used for other EPICS tools (MEDM, ALH, and Archiver...). Therefore, when a parameter is changed or wiring is changed, all we have to do is to update data in the KEKB database and re-generate updated configuration files.

For making this scheme work, it is important to keep

the database on Oracle up to date. We use web browsers such as Netscape communicator and Microsoft Internet explorer as a tool to view or update data on the KEKB database. If a user can have proper permission, he can update data on the database from anywhere where a PC and network are available.

## 2. SPECIFICATION OF DATABASE

Specification of the KEKB database system is shown bellow.

RDBMS	Oracle 7.3
Database Size	about 1GB
Server	MITSUBISHI ME-RK 460
OS	HP-UX 10.20

## 3. ELEMENTS OF THE KEKB DATABASE

The KEKB database consists of six parts, the wiring database part, the control database part, the magnet database part, the RF database part, the vacuum database part and the BT (Beam Transport) database part.

### 3.1 Wiring Database

The wiring database treats the data about wiring between two components as a form of "From" and "To" data. It can handle field bus cable connections, analog wire connections and analog cable connections. In the wiring database, the cables are treated as a batch of several wires.

### 3.2 Control Database

The control database deals with the data about control devices such as VME subracks, VXI mainframes, CAMAC crates, and racks. In addition, it maintains logs of control devices, serial numbers of modules, failure reports, delivery dates, installation dates and so on.

### 3.3 Magnet Database

The magnet database treats the data about devices related with magnets, such as magnets themselves, magnet power supplies, digital voltmeters of monitoring system and so on. It also stores measured data of magnetic field and parameters of excitation curves.

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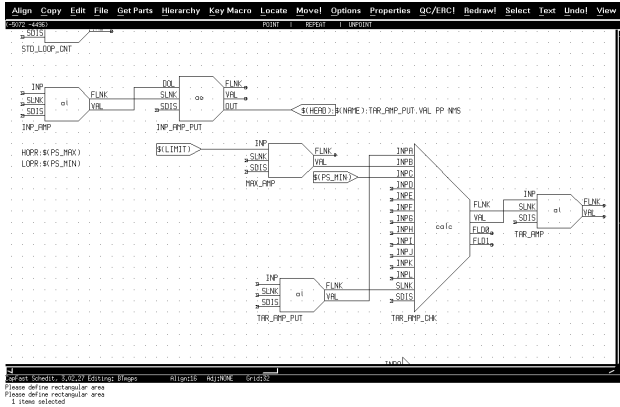


Fig.1 Record Design on CapFast

### 3.4 RF Database

The RF database handles data about klystrons, their power supplies, cavities and so on. It is under construction.

### 3.5 Vacuum Database

The vacuum database treats ion pumps, gate valves, beam ducts, and so on. It is also under construction.

### 3.6 BT Database

The BT database treats devices used in the BT system, such as magnets, screen monitors, collimators and so on.

## 4. AUTOMATIC GENERATION OF EPICS FILES

### 4.1 Type of automatically generated files

The KEKB database system generates automatically several types of configuration files used in EPICS system as listed below.

- EPICS Database
- MEDM File (\*.adl)
- EPICS Startup File

An EPICS database is a file to be downloaded into each IOC (IOC: Input / Output Controller, a VME computer), which contains the configuration of runtime database on the IOC.

MEDM (Motif based display manager) is one of client tools of EPICS system, which displays operation panels, menus and other objects on a display window. The configuration file of MEDM is named “\*.adl”

The KEKB database also generates an IOC startup file for each IOC, which is described in VxWorks script language. Each configuration file type has its own generator in the KEKB database. These generators are written in SQL\*PLUS language.

### 4.2 EPICS Database

We expect over 100,000 EPICS records in the KEKB control system. It is not feasible to fill out every field of

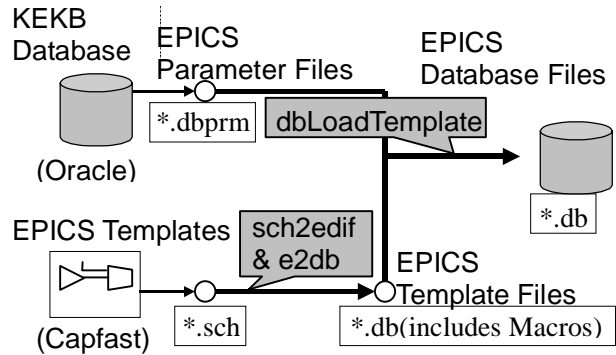


Fig.2 Flowchart (EPICS Database)

these records by hands. Some automation is necessary. We describe EPICS template records using CAD software “Capfast” (Fig. 1). Template files may include EPICS macro names. When this template database is downloaded onto IOC, a macro name will be substituted by an actual value. The KEKB database provides pair of EPICS macro name and EPICS macro value. “dbLoadTemplate” (EPICS tool) is used for downloading database. (Fig. 2)

### 4.3 MEDM Files

To generate MEDM files, we use EPICS parameter files as intermediate files. We make MEDM template files, which include EPICS macros, using MEDM as a graphical panel editor. Finally, we generate configuration file for control windows by some tools described in UNIX shell script or “awk” language.

### 4.4 VME Computer Startup Files

In the KEKB control system, over 80 VME computers are used. Each VME computer needs different startup file, since each computer uses different EPICS database file. Therefore, it is efficient to generate these files automatically. The KEKB database generates startup files directly using mainly the control database.

### 4.5 Inside The KEKB Database

Fig.3 shows how to generate EPICS parameter file inside Oracle database. “EPICS Macro Generation Engine” refers several Oracle tables such as magnet table, power supply table, wiring information tables and so on. Then, it fills EPICS Macro data, which consists of pairs of macro names and values. This engine consists of several modules, so a member of each group can register a module that generates the macros used in a new EPICS template of the group.

“Parameter File Output Engine” generates files of EPICS parameters. In addition, it outputs macros as the HTML format, so that we can check parameters through the web browser.

Both engines are described in PL/SQL language, which is extended SQL language by Oracle Corporation.

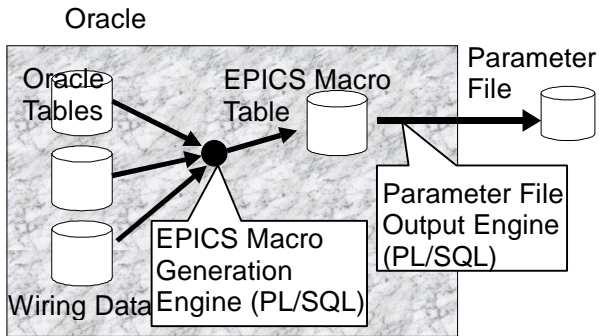


Fig.3 Flowchart (Inside Oracle)

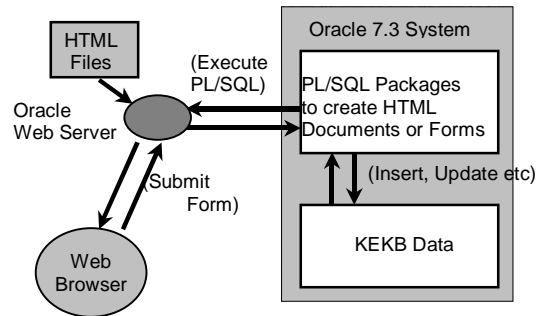


Fig.4 Access to Database Through Web

## 5. USER INTERFACE OF THE KEKB DATABASE

### 5.1 WWW Interface

We chose web browser as the client tool to access the KEKB database. There are two reasons for this choice. First, various types of computers are used in KEK, such as X terminals, Macintoshes, Windows 95's, NT's. Second, efforts to maintain applications on many clients can be avoided. Only web browsers are needed to access data.

Fig. 4 shows how to put data on the KEKB database into client browser through HTML protocol. Web page generator, which is described in PL/SQL language, fetches necessary data from the KEKB database and generates HTML documents. It also generates some web forms to access to the KEKB database. Through these forms, users can insert new data, update data or delete data.

### 5.2 Other User Inference Tool in the KEKB system

Web browser is very useful tool for a daily maintenance of the data. However, it is not suitable to record or update a large number of data. When we have to register many data to the KEKB database, we use Microsoft Excel files or CSV files and put them to Oracle, using client tools of Oracle such as SQL\*Plus or SQL\*Loader. We also use Microsoft Query, which is suitable to update many data at a time.

### 5.3 Security

To keep security, computers out of the KEK network are not permitted to access this database. Moreover, a member of a group such as control group, magnet group, can maintain data leading to his own group, while he can only view data of other groups.

## 6. CONCLUSION

We get the way that all the members of KEKB share common data that are always updated properly with this KEKB database. The cost to develop the database and the tools is not low. However, we believe that total cost is

lower than loss caused by inconsistency of data, parameters and so on.

## REFERENCES

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