A Development of Database Management Application for Level 1 Multi-unit PSA

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1. Introduction

The safety analysis of nuclear power plants has received attention as occurring the Chernobyl accident rated level 7 in International Nuclear Event Scale (INES), and the TMI accident rated level 5 in INES. The recent Fukushima accident which is equivalent level 7 of INES is a multi-unit accident, not a single-unit accident, thus the site perspective (multi-unit) PSA has emerged as an issue beyond single-unit PSA. In Level 1 PSA, the frequency of core damage is estimated through initial events, human error, and device failure rate, but for many Level 1 PSA, the amount of data is huge and various, so data management is difficult. For ensuring the safety of nuclear power plants within the same site, systematic management of failures and events occurring within each unit is required.

Therefore, we want to integrate independently managed databases into one format and develop a user-friendly system for MUPSA.

2. The application for the system

To encrypt and integrate the table format data collected by each plant and report, the system was developed as a Database Management System (DBMS), and Microsoft Office Access was used among DBMS, which was highly accessible and capable of handling databases in the form of files.

However, since DBMS alone cannot utilize all the functions covered in this system, a program has been developed for using the functions of DBMS and implementing the unique functions for performing the MUPSA [2-5]. This program has been named MSPAR-DB.

3. Functions of the application

This application typically consists of the functions-Information storage and view, deducing classification code, and filtering from classification code.

3.1 Information storage and view into single format

The events in each unit have unique databases in the form of operator reports, so this application is not needed for a single unit. However, when comparing mean and error factor values, etc. of each unit during multi-unit PSA, it is necessary to gathering data into a single-table.

This application allows intuitive comparison of the data of each unit by storing data in the same format for all units. This is treating basic events, human error events, and initial events.

To take the data integrity features provided by DBMS, Continuous update and maintenance of data are performed only through the DBMS program-Microsoft Office Access. In addition, for batch management of data, the application uses the single unique format, which requires system users to learn this format.

3.2 Deducing classification code from an event name

Basic events and human error events basically contain information about a system code, a component code, and a failure mode related with the event, the codes are described in the event name according to the unique naming conventions of the reactor model report.

For example, in the PSA report of Shin Kori 1 and 2, the naming convention of fault tree basic events is defined as shown in Fig. 1 [1].

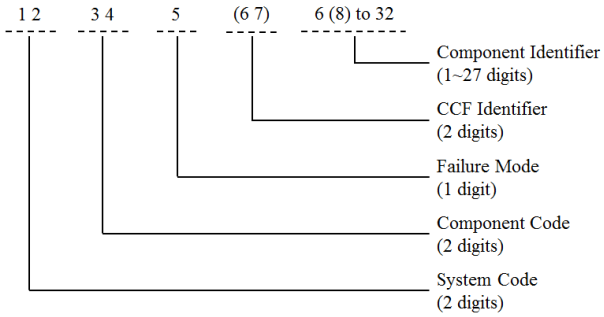

Fig. 1. The naming convention of basic events

By the naming convention, the basic event named AFMPS01AA indicates that the system code is AF, the component code is MP, the failure mode is S, and the component identifier is 01AA.

This application can deduce the system code, the component code, and the failure mode from the basic event name. The naming conventions may vary from model to model, the conventions have been scripted so that classification codes can be deduced for other models of each unit.

3.3 Filtering by classification code using DBMS query

This application can display the newly updated classification codes of DBMS which are deduced by the system, and it can filter the data through the selection of the list. In addition, it used query language of DBMS for filtering performance. Query is a phrase that requests information from DBMS, it provides a strong function

when managing databases. A user can write queries directly to filter the data, but the queries is very complex because this application internally attaches a lot of conditions at same time and filters it. Therefore, this application writes queries automatically by conditions, and requests to DBMS.

For example, to view the list of events in Shin Kori 1 and 2 those system names are auxiliary feedwater system, use the query is shown in Fig. 2.

```
 SELECT SUB_D.* FROM
(SELECT SUB_N.* FROM
(SELECT SUB_F.* FROM
(SELECT SUB_C.* FROM
(SELECT SUB_S.* FROM
(SELECT Event.* FROM Event INNER JOIN
System ON Event.SystemCode =
System.SystemCode AND Event.NppCode =
System.NppCode WHERE System.SystemName =
'Auxiliary Feedwater System')
AS SUB_S)
AS SUB_C)
AS SUB_F)
AS SUB_N INNER JOIN Npp ON SUB_N.NppCode =
Npp.NppCode WHERE Npp.NppName = 'ShinKori
1,2') AS SUB_D;
```

Fig. 2. The query to filter the events with specific conditions

The meaning of this query is as follows. In the basic event table, the table name is SUB_S, it have the filtering results with system name is auxiliary feedwater system, The SUB_S table turns into SUB_C and SUB_F by the other filtering results (In this query, a component code and a failure mode are not included in the condition, so the result of SUB_C and SUB_F is the same as SUB_S), The SUB_F table turns into SUB_N by the filtering results with the plant name is Shin Kori 1 and 2. The final filtering results table is SUB_D. Such this query has standard structure of a basic event filtering query, if another phrase is added into here, it is possible to get the number of data retrieved, etc.

4. Results

Common Cause Failure Factor (CCF) can vary depending on the total number of same units. Similarly, for considering multi-unit CCF, Identifying the use and number of identical components between different units was necessary. Using MSPAR-DB, it was easy to identify whether the same device was used by searching a system code and a component code, etc., and it was also possible to make estimate of parameter values incorporated in the multi-unit PSA model.

5. Conclusions

The data recording the basic events, human error events, initial events managed by different type of nuclear power plants in Korea using DBMS has been prepared and the MSPAR-DB system has been developed with the function to collect and sort data and filter data.

This application has a more user-friendly and objective taxonomy with the addition of English-Korean translation functions, search functions, and list of classification codes.

These data can be considered as the regulatory verification database, if a probabilistic analysis of the various parts of the plant in the future is required or needs to be modified, it is possible to make an unambiguous analysis of whether each of the data corresponds to the data in the specified references.

For further works, data mining technology will be applied to this application for producing more valuable information.

6. Acknowledgements

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