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Development of Web-Based Plant Reliability Information System (PRinS)

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1. Introduction

Probabilistic safety assessment is a systematic technique which estimates the degree of the risk impact to the public due to accident scenarios. Estimating the occurrence frequencies and consequences of potential scenarios requires a thorough analysis of the accident details and all fundamental parameters. The robustness of PSA to check weaknesses in a design and operation will allow a better informed and balanced decision to be reached.

The fundamental parameters for PSA, such as the component failure rates, should be estimated under the condition of steady collection of the evidence throughout the operational period. However, since any single plant data does not sufficient enough to provide an adequate PSA result, in actual, the whole operating data were commonly used to estimate the reliability parameters for the same type of components. The reliability data of any component type consists of two categories; the generic data those are based on the operating experiences of whole plants, and the plant-specific data those are based on the operation of a specific plant of interest.

In the United States, there are many nuclear operation companies. They summit LERs (License Event Reports) and raw data of each nuclear plant to EPIX (Equipment Performance and Information Exchange system), which is run by INPO. USNRC takes databases from EPIX, or generate the generic database from the studies of institutes such as INEL, if needed. Utility usually use those database.

Considering that there is only a single Nuclear Operation in Korea, Korea Hydro & Nuclear Power should role the main part. KHNP has been running Enterprise Resource Planning system since July of 2003, so the foundation has been set to save a lot of efforts such as time and money to make a new database. KHNP has developed a reliability database system named PRinS based on the ERP system to collect and analyzes component data not only for PSA but also for the Maintenance Rule.

2. Background of PRinS Development

In Korea, KOPEC had collected reliability data for PSA all domestic Nuclear Power Plants from the commercial operation to 2002, and KAERI developed reliability database system KIND (Korea Information System for Nuclear Reliability Database) for Yonggwang unit 3, 4 and Ulchin unit 3, 4 [1]. So far reliability data, which have been analyzed by external contractors such as KOPEC and KAERI, have been stored as Excel or MS-Access file format for each unit, but managed items and scope of analysis were different case by case. Moreover, an integrated database management system has not been set up yet.

Raw data has been stored in ERP system since its operation, however systematic review has not been made to apply the component failure and maintenance history for PSA. By the level of user's knowledge on ERP system, adequate data searching and collecting results could vary, and most of the users have hard time doing them. Furthermore, a standard procedure has not been established. The reliability databases, which have been made before ERP system and stored as separated files, also need to be converted and managed in accordance with new database system and methodology. A reliability database should contain data such as component reliability related data, plant outage history, initial accident frequency, common cause failure factors, human performance reliability data, and so on.

The PRinS is a web-based system on a UNIX server with Oracle Relational Data Base. It is designed to be applicable for all domestic NPPs with the same database structure and the same web interface. It would not be necessary to develop another program to analyze other domestic nuclear power plants. Single-sign-on feature would enable users to log on PRinS system without extra logging process from KHNP's groupware system. Figure 1 shows the system configuration of ERP system and PRinS

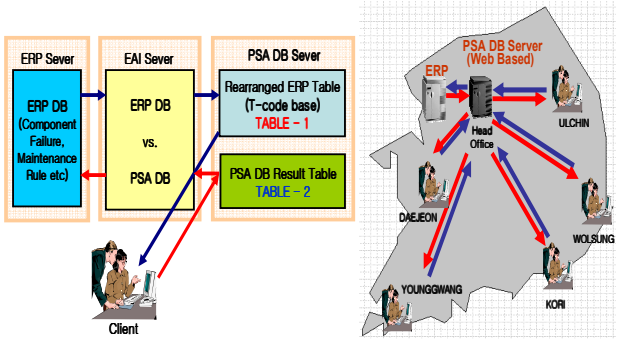

Fig. 1. System Configuration of ERP System and PRinS

3. Method and Result of PRinS

Three types of reliability analysis are performed for the components: Failure rates vs. the plant operating hours for the components except rotating components. Failure rates vs. the component running hours for

rotating components (e.g., pumps). Failure probability vs. the number of operation failure (e.g., fail to run for pumps, and fail to open or fail to close for valves)[2].

PRinS takes raw information from ERP system, Plant Information system, and RIMS. Data from ERP system is automatically transferred on-line in real time, but users should extract required data from PI and RIMS manually.

3.1 Data Collection from ERP System

PRinS collects order, notice, operation log sheet, LCO application notice, MR related performance history data from ERP system. When data is generated in ERP system, EAI(Enterprise Application Integration) transfers it to the PRinS in real time. PRinS database has base tables for orders and notices, and related tables for a MR condition monitoring and FID (Functional Importance Determination). Long text data from ERP system is transferred via FTP protocol, not via EAI method. Users can collect data for component failure and maintenance, and unavailability information.

Figure 2 shows a search page for the base data from ERP system on PRinS.

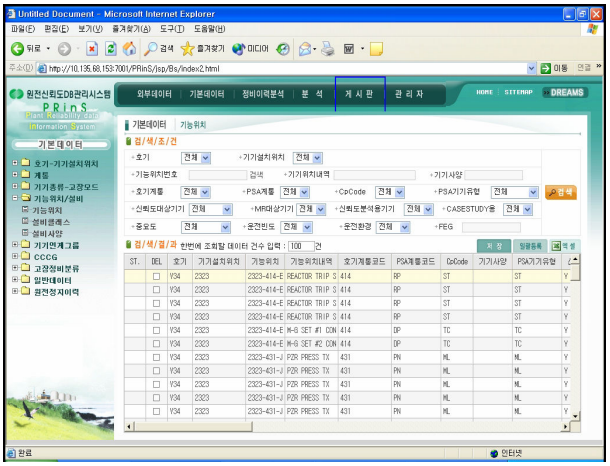

Fig. 2. Screenshot of PRinS

3.2 Data Collection from Plant Information System

PI system shows operating status from Plant Monitoring System of the plant. Data from PI system contains useful information such as component operation history. Precise operation time and number of component operation can be calculated from these.

PRinS and PI system are not connected on-line, rather a special program gathers required information off-line, and users should upload the information to PRinS. The program is based on the PI data link program. It downloads the data in Excel file format, and it is written in Visual Basic. To use the program, users should identify and list up the required tags from PI tag list first.

3.3 Data Collection from RIMS

PRinS and RIMS are in off-line connection, as well. Users should download OOS and RTS information from RIMS in Excel file format, and upload the required information to PRinS.

Plant operation section personnel generate RIMS Operator Mode information, which can be made by using the PSA component failure analysis, unavailability and return to operation time, and related information.

4. Conclusion and Future Study

This paper presents reliability database system named PRinS, which is connected to the ERP system with web interface on a UNIX platform with Oracle RDB. It is designed to be applicable for all domestic NPPs with the same database structure and the same web interface, so additional program development would not be necessary for data acquisitions.

Category standardization for systems and components were necessary and carried out to analyze all domestic NPPs' data. SysCode (for system code) and CpCode (for component code) were newly defined for domestic plants, so Bayesian update with the generic data can be accomplished automatically. PRinS would be useful not only for PSA and Risk Informed Application, but for plant operation and maintenance optimization. Furthermore, this systematic database utility program would enhance effective support for the PM Template, Maintenance Rule and Equipment Reliability (ER) development.

REFERENCES

[1] "Development of the Software for the Component Reliability Database System of Korea Nuclear Power Plants," KAERI, KAERI/TR-2130, March, 2002.
[2] "Development of Procedure for Collecting and Analyzing Component Reliability Data," KAERI, KAERI/TR-2132, March, 2003.