Development of Web-Based Reliability Data Base Platform

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1. Introduction

Probabilistic safety assessment (PSA) is a systematic technique which estimates the degree of risk impacts to the public due to an accident scenario. 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 sufficiently enough to provide an adequate PSA result, in actual, the whole operating data was 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 that is based on the operating experiences of whole plants, and the plant-specific that is based on the operation of a specific plant of interest. The generic data is highly essential for new or recently-built nuclear power plants (NPPs).

Generally, the reliability data base may be categorized into the component reliability, initiating event frequencies, human performance, and so on. Among these data, the component reliability seems a key element because it has the most abundant population. Therefore, the component reliability data is essential for taking a part in the quantification of accident sequences because it becomes an input of various basic events which consists of the fault tree.
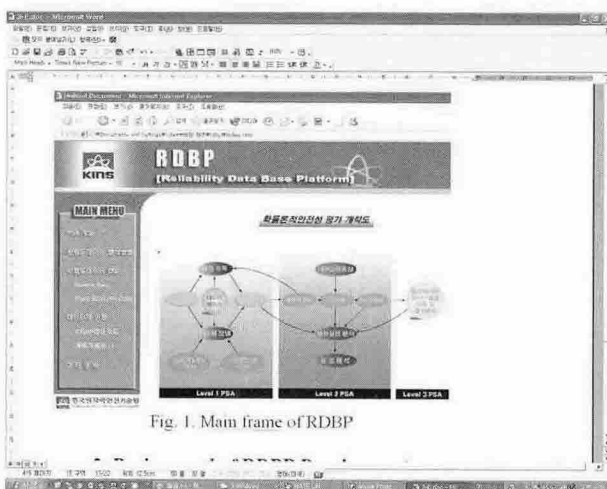

Fig. 1. Main frame of RDBP

2. Background of RDBP Development

Depending on the reliance of reliability data, e.g. the parametric estimation of random variables, the PSA results may show a significant deviation. For instance, the failure data change in any components can directly affect the PSA results, which becomes one of regulatory issues. Therefore, in order to support the regulatory decisions on reliability data estimation, a data base which consists of most of basic information of specific components is desired.

To meet the above desire, a data base is provided basically including the diagrams, illustrations, and main texts. With an effort to the domestic and international survey of relevant documents, many information sources are collected. This information has been implemented using a web-based design and constructed as a platform, here called RDBP (Reliability Data Base Platform). Fig. 1 shows a main frame of web-based RDBP. This figure denotes the relationship between the overall PSA (Level 1, Level 2, and Level 3) procedure and element for reliability database analysis.

3. Main Features of RDBP

The RDBP was originally developed as a web-based design using the HTML (hypertext markup language) tool, where images, tables, tags, and style-texts are implemented. As shown in a main menu as positioned in the left side of Fig.1, the outlines of web-based RDBP are as follows;

(1) overview of PSA,
(2) methodology of reliability data analysis,
(3) component reliability data base (main element),
(4) data application using computer code (e.g. KIRAP),
(5) the others.

As both of first and second parts, RDBP contains explanation for concepts on PSA elements and other useful information. The first part for concepts on PSA addresses the overall methodology for all work scope of PSA. The second part for methodology of reliability data analysis is prepared using the information from domestic PSA report, i.e. Ulchin 5&6 PSA [1]. The basic techniques for reliability data analysis are denoted.

The explanation and detailed procedure for the information/data exchange between various computer codes (i.e. KIRAP, CAFTA, NUPRA, etc) and example illustrations for doing this work are provided in fourth part of main menu of RDBP. The fifth part consists of

the tables for comparison of frequency and calculation method for initiating events in domestic NPPs, and the information of abbreviation [2].

The main element of RDBP is a third part (reliability data base) which provides the information on the basic configuration, summarized operating function, failure mode used in PSA, and corresponding failure rate, respectively, as user-conveniently as possible. Basic information for component types and their failure rates are mainly adopted from the most updated data of ALWR URD [3] prepared by EPRI.

The component types are divided into four representative groups; pump, valve, I&C, and "the others." For example, motor-driven air compressor, ventilation fan, strainer, battery, and battery charger reside in the group of "the others." Totally 32 component types are currently considered.

Fig. 2 illustratively denotes the composition features of check calve, which is selected among the valve component types. Since the pictures, diagrams and explanations were rarely found in domestic and/or international sources, there was a lot of difficulties in data searching for providing the details. Moreover, the explanations for well-known components such as motor-operated valves were simply provided only for the fundamental types, so the different characteristics for other specific types were not touched.

In a case of specific components, such as strainer ("the others" group), due to the lack of available knowledge and/or information sources, the explanation for the functions has been very vague. Furthermore, for the components used in different accident mitigating functions, such as motor-driven pump (it is usually used in residual heat removal system, emergency core cooling system, and containment spray system, etc) the corresponding failure rate should be separately provided. According to above limitations, current RDBP needs to improve its presentation.

Fig. 2. Presentation of example valve type (check valve)

4. Conclusion and Further Study

The RDBP program has been derived for the representative components touched in PSA, and tried to demonstrate the functional details of components, as well as basic PSA information. Even though the lack of information may be existed, the current web-based RDBP can be utilized by various users, including the regulators and the public. Also, it may be used for an educational purpose, and be provided as a reference program to understand the essential concepts of the PSA. In that sense, the RDBP program could be a basic foundation for establishing risk-informed applications.

It is noted that still there is an urgent need to update the specific characteristics of the RDBP. Some absent components and plant-specific data for domestic NPPs should be additionally provided. In order to enhance the RDBP effectively, experts' recommendations and comments are always welcomed.

REFERENCES

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