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Development of Risk Assessment Simulator Using MACCS2 Code (RASUM)

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1. Introduction

Radioactive materials would be released to the atmosphere in case severe accidents at nuclear power plants occur. When such an accidental release occurs, the radioactive materials in the plume while dispersing in the atmosphere would be transported by a prevailing wind. As a result, the radioactive materials would contaminate the environment, and finally the population would be exposed to radiation. The consequences resulting from such an accidental release are related to health effects. These consequences are estimated by the method of the in Level 3 PSA. The offsite health effect assessment of an accidental release from a nuclear power plant is a function of many factors such as the source terms, weather condition, emergency response plan, and plant specific data. An assessment of the impact of such releases to the environment and the general public requires the calculation of airborne and ground concentrations of each radionuclide for various distances from the reactor. When they are released into the atmosphere, radioactive gases and aerosols follow prevailing winds and are diffused due to atmospheric turbulence. The prediction of dispersion is most commonly made from the Gaussian plume model using its simplified input requirements and reasonable agreement with experimental data over flat terrain.

In this study, we've developed web-based risk assessment simulator by using MACCS2 code (RASUM) with input values of source term, meteorological data, ground data and population distribution data, etc for KSNP (Korea Standard Nuclear Power Plant)[1] when SBLOCA breaks out.

2. Methods and Results

2.1 Background of RASUM

In this study, we've created web-based risk assessment simulator by using HTML (hypertext markup language) tool. And health effect assessment for domestic nuclear power plant is limited to only specific numbers of plants and is required for more study. Also there are lots of complexities in consequence of health effect assessment and it's hard for the public to understand. The ultimate goal for developing web-base RASUM is which user can use the output and input values such as source term, meteorological data, ground data and population distribution data for Level 3 PSA step with data created by regulators, operators and public users. The engine of a Web-based RASUM used MACCS2 code developed by NRC in US. Efficiency of MACCS2 code is wide, it involves all the economical and radiological effect. Typical use of MACCS2 code are PSA, sensitive analysis to help understanding the main variables when performing the PSA, expenses based of economical efficiency and effect analysis, etc. Figure 1 shows the main frame of RASUM.

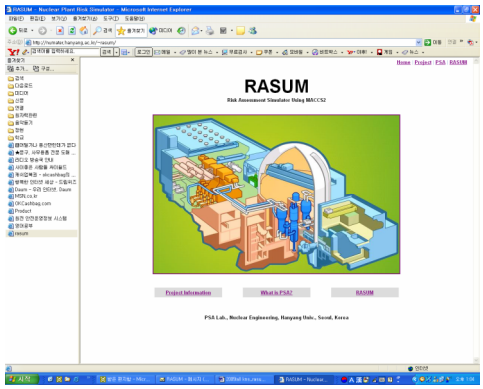

Figure 1. Main Frame of Risk Assessment Simulator Using MACCS2 Code

2.2 Characterization of MACCS2 in RASUM

In MACCS2[2], the dispersion and deposition of radionuclides released from the reactor containment to the atmosphere were modeled with a Gaussian plume model. Radiation doses to the population were calculated based on the radionuclide concentration that is predicted by the dispersion models. The exposure pathways considered in the evaluation of health effects are: (1) exposure to the passing plume, (2) exposure to radioactive materials deposited on the ground, (3) exposures to deposits on skin, (4) inhalation of radioactive materials directly from the passing plume, (5) inhalation of radioactive materials resuspended from the ground by natural and mechanical processes, (6) ingestion of contaminated foodstuffs, (7) ingestion of contaminated water. Evaluation of MACCS2 code used in this study is composed of 3 modules, which is

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treating the input data with verifying the efficiency, modeling the condition and treating the output data. It is composed of 3 main input data and the others needed to run the code. Especially performing this study, it was calculated only considering emergency phase. During this time, other different methods as sheltering and shield by dose and evacuation can be suggested considering all the radioactive plume and exposure from ground contamination. Intermediate and long term phase are calculated by CHRONIC module of MACCS2 code. During this period, radioactive plume disappears and only the exposure by ground contamination is considered. Then the defensive means such as temporary sheltering, decontamination and setting the restricted area are dealt. In this study, CHRONIC module is not used since it is not focused on evaluating the radiation effect. DOSDATA input data including conversion factor, meteorological data including wind direction, wind velocity, atmosphere stability and cumulative precipitation, etc. by each hour in a year, population distribution and data of the site near nuclear plant providing information about land fraction are used.

2.3 Main Features of RASUM

The RASUM was originally developed as a web-based design using the HTML (hypertext markup language)[3] tool, where images, tables, tags, and style-texts are implemented. As shown in a main menu as positioned in Fig.1, the outlines of web-based RASUM are as follows;

(1) Development Background,
(2) Concept of PSA,
(3) Health Effect Assessments,
(4) Key Data,
(5) MACCS2 Run.

Purpose and the background of developing web-based RASUM are written in development background. The second part for concepts on PSA addresses the overall methodology for all work scope of PSA[4]. The third part established KSNP as a Reference part for users to confirm the results of an off-site health effect assessment graphically such as an average individual risk, early and latent cancer fatalities, etc, which is divided into 10 different sections in the radius of 80km in map. This is the result of performing about KSNP as a reference plant for on example. Fig2 shows the result of an off-site health effect assessment for reference plant which is established by RASUM when SBLOCA breaks out. In fourth part, information about Source Term Data on 9 release group, Meteorological Data throughout the year, Population Distribution Data and Ground Data around Reference Part are established as key data to perform MACCS2 code. In last part, it is expected to link the web for users to perform MACCS2 code written in ANSI Standard FORTRAN 77. Also, it is expected for users to enable the modification and save the input data so that users can see the result they expect.

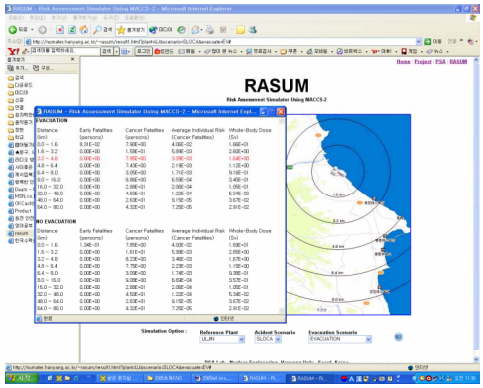

Figure 2. Result of SBLOCA in KSNP Using MACCS2

3. Conclusions

In this study, for performing overall level 3 PSA, we developed web-base risk assessment simulator by using HTML tool. User can see the result graphically, which is the output by running actual MACCS2 code and creating database for off-site health effect assessment.

And most users can understand and access the general concepts and methodology of PSA. Created RASUM can be used for risk informed regulation and application, accident management plan, public acceptance, etc. In order to enhance the RASUM effectively, experts' recommendations and comments are always welcomed.

Acknowledgement

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