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Radiological Dose Assessment Systems to Support the Nuclear Emergency Planning and Preparedness in the KAERI Site

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1. Introduction

Radioactive materials released to the environment during accidents lead to radiation-induced health effects to humans through various exposure pathways. To mitigate on-site radiological consequences, above all, a rapid prediction of radiological dose may be more crucial than a reliable one. To support the protective actions in the case of an accidental release from the nuclear facilities including the HANARO research reactor in the Korea Atomic Energy Research Institute (KAERI) site, a series of tools have been developed. In this manuscript, radiological dose assessment systems developed to date to support an emergency planning and preparedness are introduced.

2. Processing of Meteorological Data

Meteorological data are an essential element to predict a radiological dose. In the KAERI site, a meteorological tower with a 75m height is in operation. Meteorological data are being measured at 10m, 27m and 67m heights from the tower, and transmitted to the Meteorological Data Processing System (MIPS) installed at the headquarters for the emergency measures through wireless communications. Meteorological signals are transmitted every 2 seconds, 10 minutes averaged data are stored in the system. Atmospheric stability is estimated by two kinds of methods ; one is estimated by the standard deviation of a wind direction, another is estimated by a temperature difference between two different heights. Figure 1 shows the graphic display of the meteorological data on the MIPS.

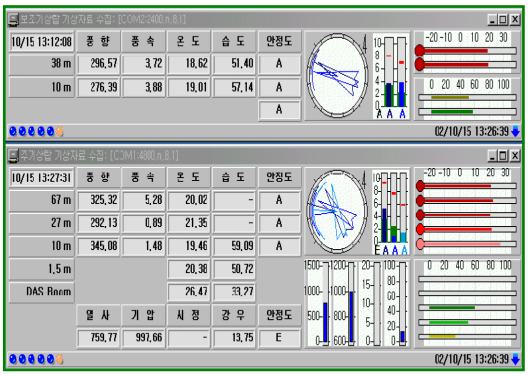

Figure 1. Graphic display of meteorological data on the MIPS.

3. Radiological Dose Assessment

In general, the following exposure pathways are considered for a radiological dose assessment ;

1) external exposure from radioactive cloud
2) external exposure from contaminated ground
3) internal exposure from inhalation
4) internal exposure from food ingestion.

The influence of exposure pathways may be different with the time following an accident. In a release phase of radioactive materials, exposures resulting from 1) and 3) may be influential. On the other hand, exposures resulting from 2) and 4) may be influential in a post-release phase. In spite of the complexity of topography, a straight-line Gaussian plume model is used to predict a ground-level air concentration because of less meteorological data and a shorter computational time. Figure 2 shows the graphic display of the radiological dose assessment system. A variety of information is presented on the screen ;

1) effective dose and equivalent dose for thyroid
2) absorbed dose rate in air
3) radionuclide concentration in air
4) area that protective actions should be taken.

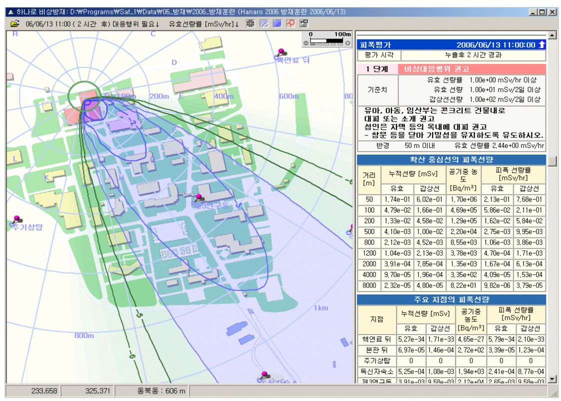

Fig. 2. Graphic display of radiological dose assessment system.

3. Dose Coefficients

Another crucial element for a radiological dose assessment is a dose coefficient which is a quantity to convert a radioactivity intake to human organs or a radionuclide concentration in an environmental media into a radiological dose. A new regulatory system in

Korea has been introduced since 1998, which is based on the ICRP-60 [1,2]. Dose coefficients should be taken with care as an input parameter for a dose assessment because of a great difference according to the age of a exposure receptor, chemical forms of radionuclide and particle size. To facilitate in the use of dose coefficients, a software, called Handbook of Dose Coefficients (HDCs), has been developed. Besides dose coefficients, it provides a variety of information including radioactive effluent concentration limits (ECLs) and decay characteristics of radionuclides. Figures 3 and 4 show the starting screen of the HDC and its displayed results, respectively.

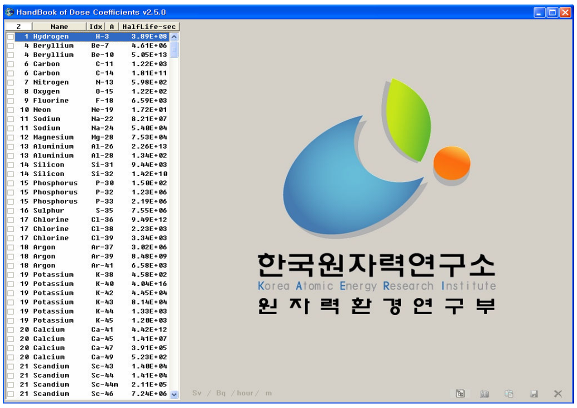

Figure 3. Starting screen of Handbook of Dose Coefficients (HDCs).

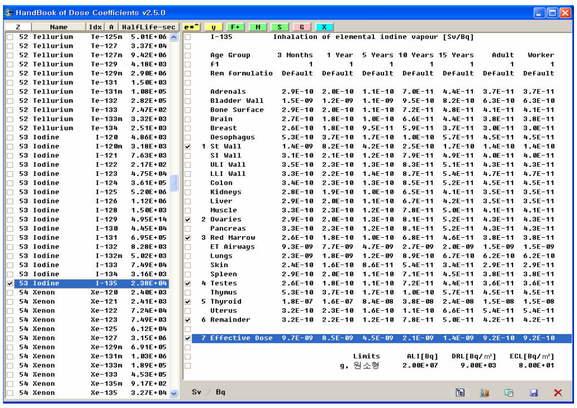

Figure 4. Displayed results of Handbook of Dose Coefficients (HDCs).

4. Conclusion

A series of tools for a radiological dose assessment during an accidental release have been introduced. These are in use not only for an emergency planning and preparedness of the nuclear facilities in the KAERI site, but also for emergency training. In addition, these provide information for the positioning of the environmental monitoring. Emergency staff may suffer from psychological chaos during real accidents. Therefore, an automatic and integrated system is needed for a more efficient support of the protective actions.

REFERENCES

[1] Ministry of Science and Technology (MOST)'s Notice 2002-23, 2002.

[2] ICRP, ICRP Publication 60 – 1990 Recommendations of the International Commission on Radiological Protection, 1991.